Section 4 Results of Fieldwork

Due to the size of the survey area, which spans 7.4 miles (12.3 km) and crosses through varying geographic areas, the fieldwork results will be presented in arbitrary segments, previously delineated during project planning. Phase I of the HHCTC Project has been divided into 17 construction sheets (Figure 33 & Figure 34). Below are the results of fieldwork as it relates to each construction sheet.

4.1 Construction Sheet RW001

Construction Sheet RW001 includes a 2,600 ft (0.8 km) segment of the proposed transit corridor, and includes the proposed East Kapolei Station and Park and Ride (P&R) (Figure 35). Two test trenches were excavated at both the station and park and ride (Figure 36). Additionally, one column test pit (C-1) was also excavated (see Figure 35), totaling 5 test excavations within Construction Sheet RW001.

4.1.1 Pedestrian Inspection

The site for the park and ride facility is located at the current construction baseyard for the North-South Road construction endeavor (Figure 37). The location for the East Kapolei Station as well as this section of the rail route was situated along the same route as North-South Road (transit line is proposed to run along its western side) (Figure 38). A newly created drainage canal is also located along the new roadway. All areas were heavily impacted by the road construction endeavor as well as the previous intensive agricultural activity. No cultural resources were observed during the pedestrian survey of this portion of the project area.

4.1.2 GPR Survey

Prior to excavation, each test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, each test area was excavated to compare the results of the GPR survey with the observed stratigraphy. Figure 39 through Figure 53 consist of a stratigraphic profile, a photograph, and a GPR profile for each of the 5 test areas excavated within Construction Sheet RW001.

In general, the results of the GPR survey were inconclusive. No clear stratigraphic interfaces could be defined, and subsurface utilities observed during test excavations at the East Kapolei P&R were not located (see Figure 39 & Figure 42). The maximum "visibility" within the study area ranged from 75 to 100 cm below the surface. It is believed that the environmental conditions present within Construction Sheet RW001 are not conducive for an accurate GPR survey. Based on a review of USDA soil data, the National Resources Conservation Service (NRCS) has indicated that GPR suitability in this area is moderate to low (Figure 9).

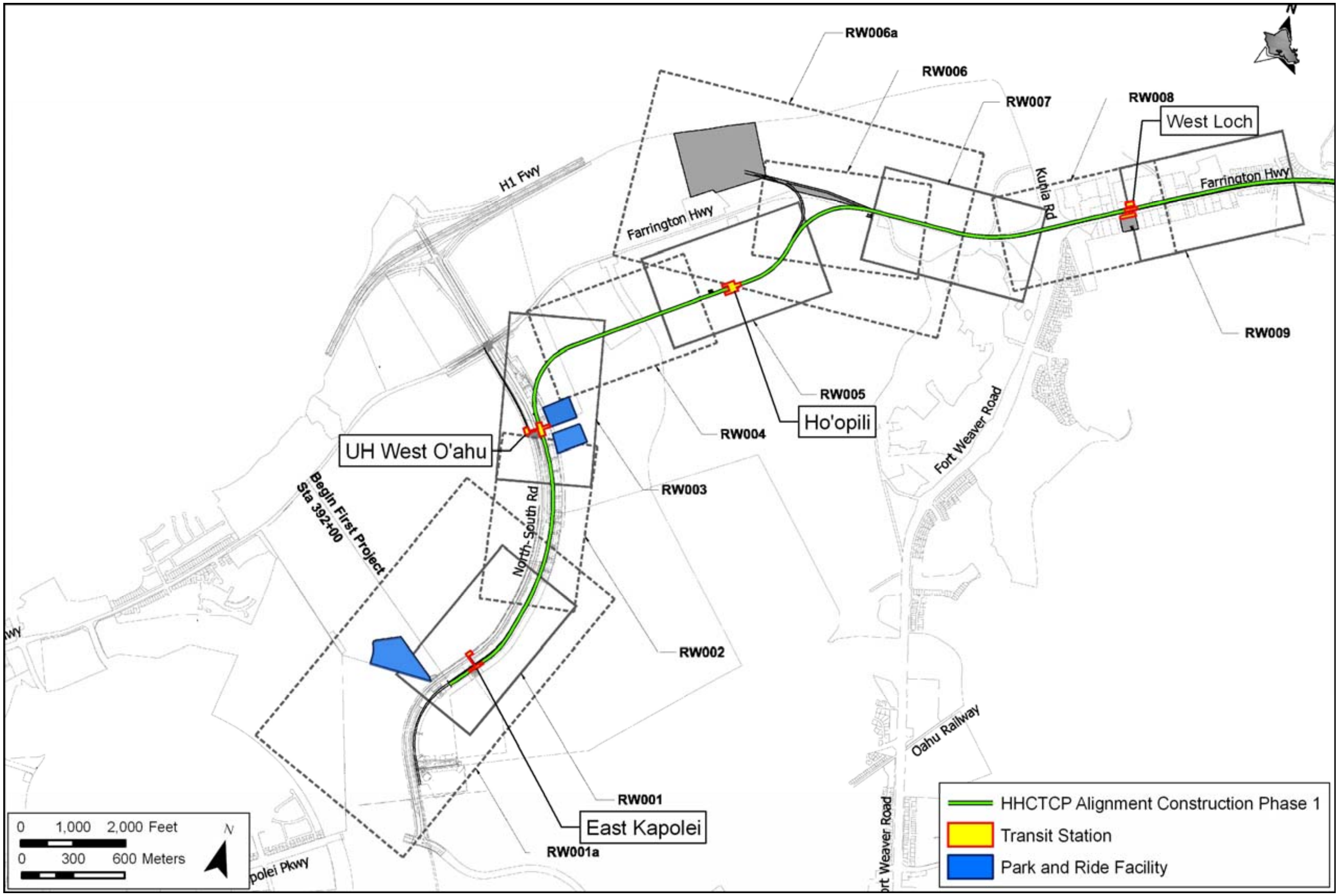

Figure 33. HHCTC Project Right of Way Map Index 1

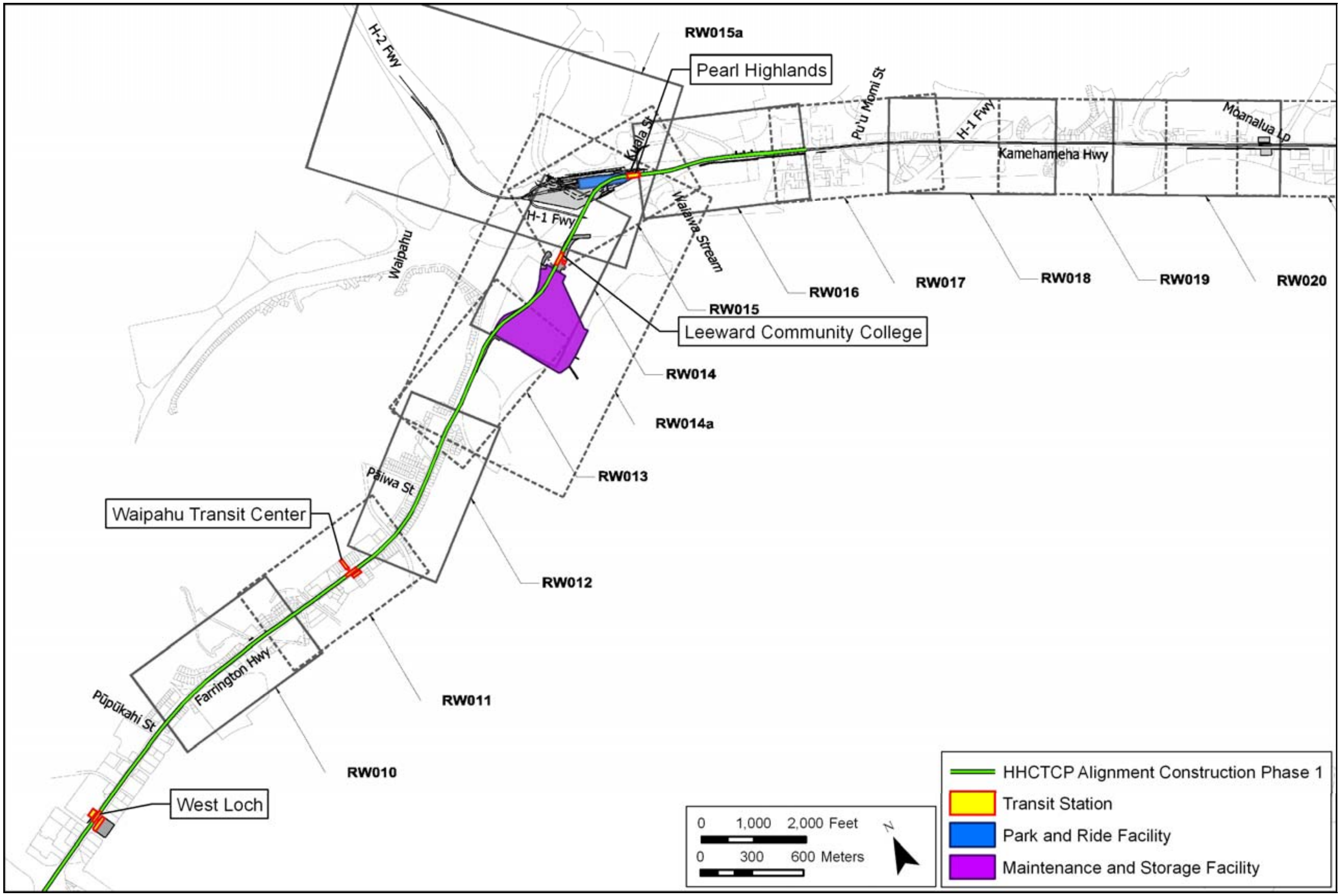

Figure 34. HHCTC Project Right of Way Map Index 2

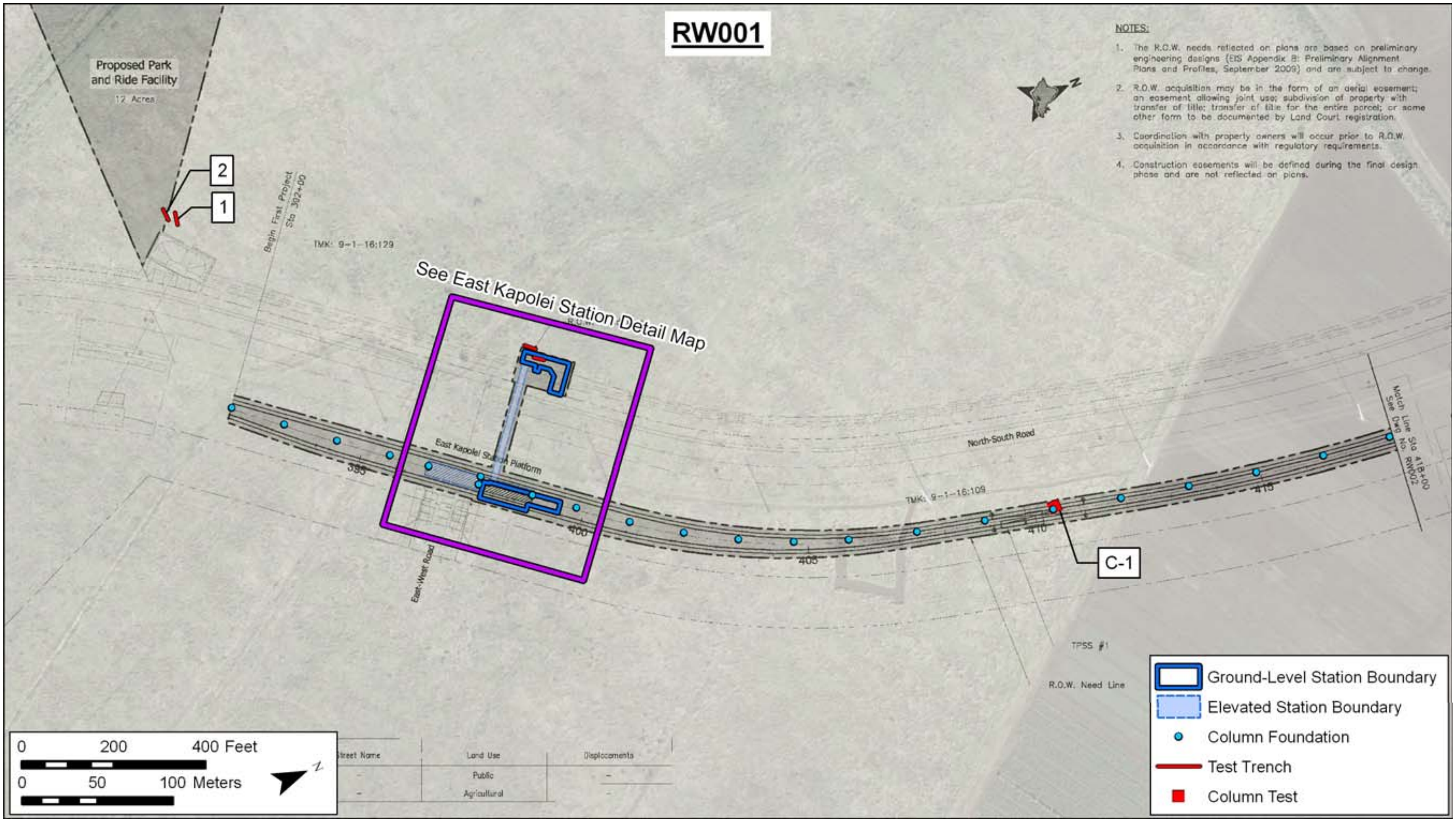

Figure 35. Construction Sheet RW001 showing location of test excavations

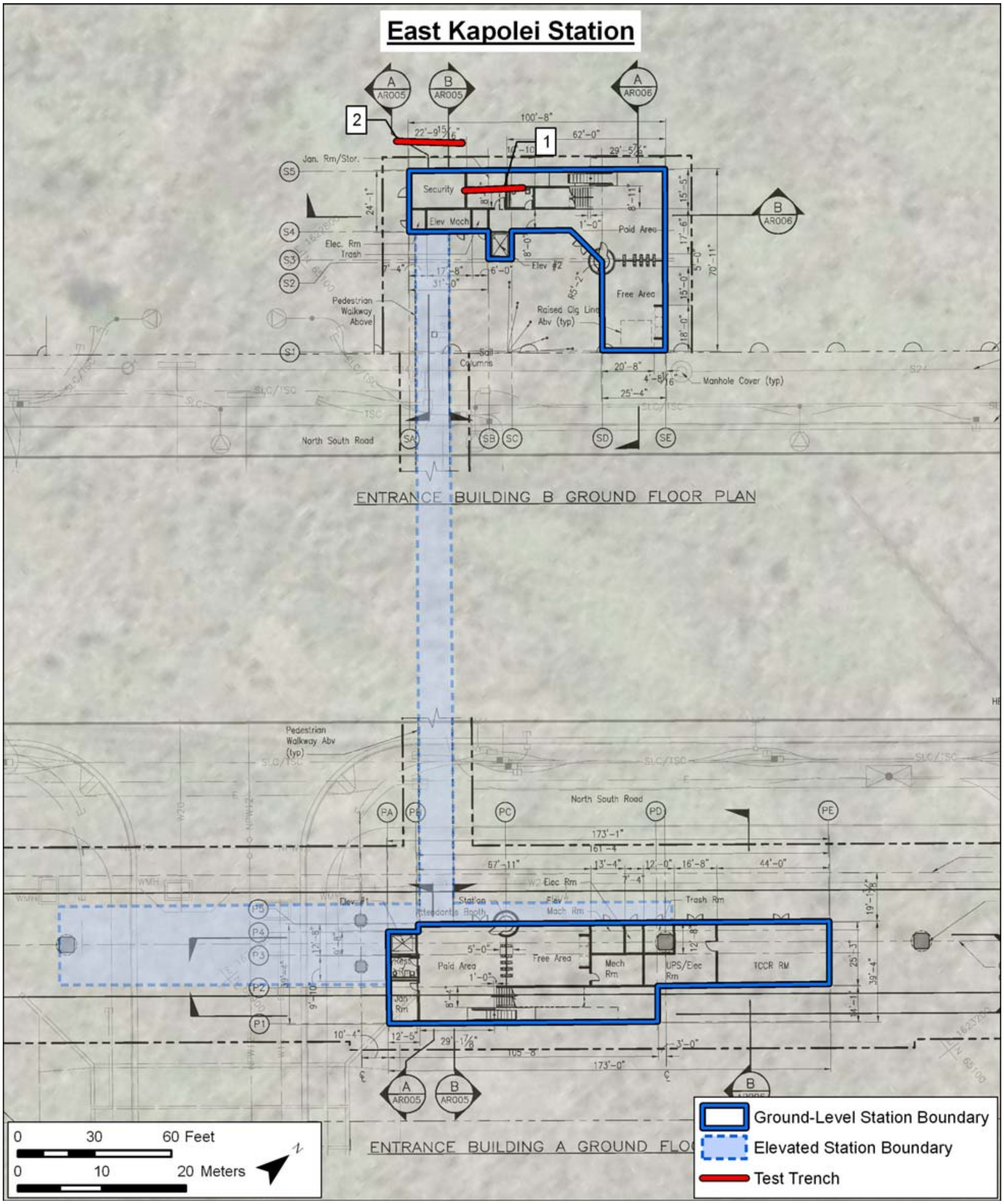

Figure 36. Floor Plan of East Kapolei Station showing location of test trenches

Figure 37.Photo of proposed East Kapolei Park and Ride Facility located at the current baseyard for construction of North-South Road

Figure 38. Photo of projected route of transit between East Kapolei Station and UH West O'ahu Station, which follows along North-South Road (under current construction)

4.1.3 Subsurface Testing

4.1.3.1 Stratigraphic Summary

Five (5) test excavations were placed within the area delineated by Construction Sheet RW001 (see Figure 35 & Figure 36). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 39 to Figure 53).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Of note was an area of disturbance ranging from 0 to 100 cmbs within most of the test excavations. This disturbance was determined to be associated with modern agriculture (i.e. tilling of the soil and irrigation line installation) as this portion of the project area is situated within actively cultivated fields. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.1.3.2 Excavation Documentation

East Kapolei P&R Test Trench 1

Orientation	284° TN
Length	8 m
Width	0.7 m
Maximum Depth	150 m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil and instillation of water lines).

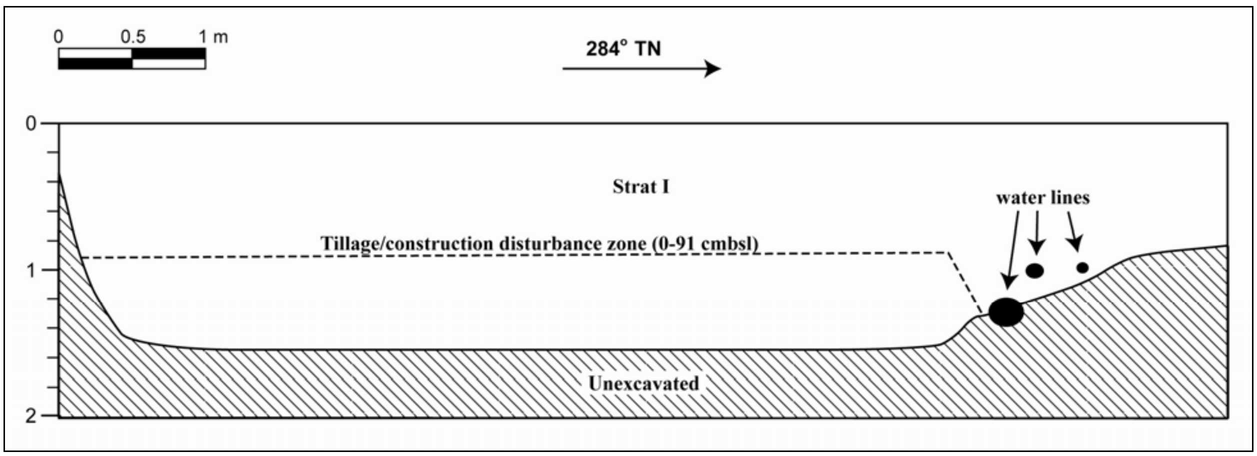

Figure 39. Profile of East Kapolei P&R Test Trench 1

Figure 40. Photograph of East Kapolei P&R Test Trench 1, view to south

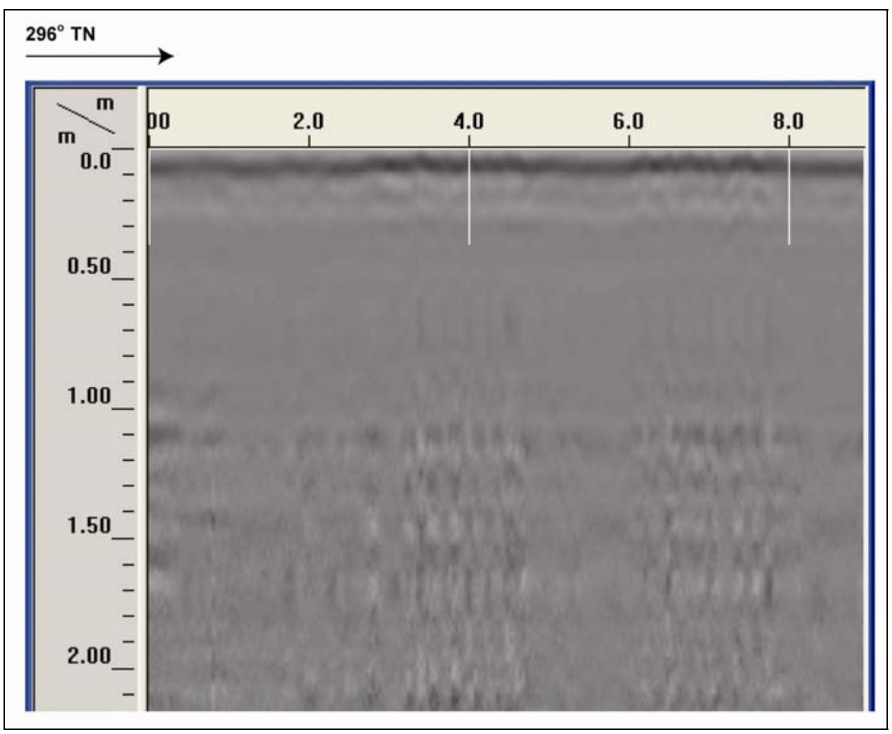

Figure 41. GPR Profile of East Kapolei P&R Test Trench 1

East Kapolei P&R Test Trench 2

Orientation	295° TN
Length	8m
Width	0.7 m
Maximum Depth	1.5m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil and instillation of water lines).

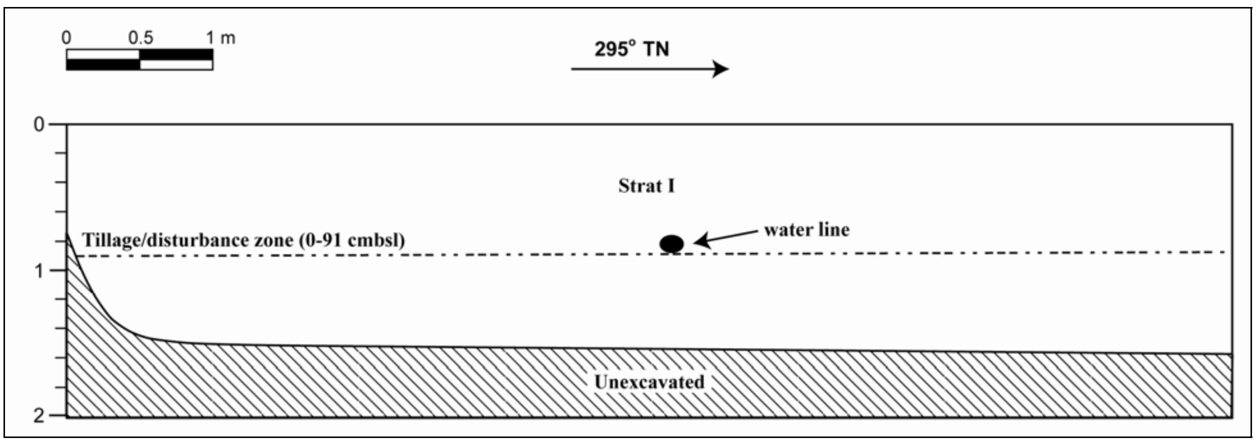

Figure 42. Profile of East Kapolei P&R Test Trench 2

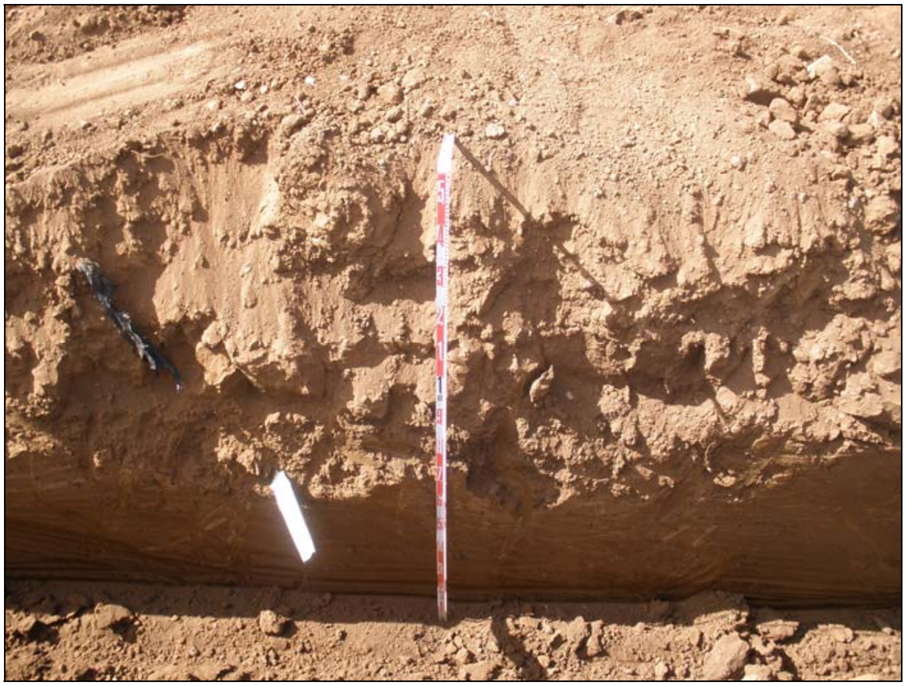

Figure 43. Photograph of East Kapolei P&R Test Trench 2, view to south

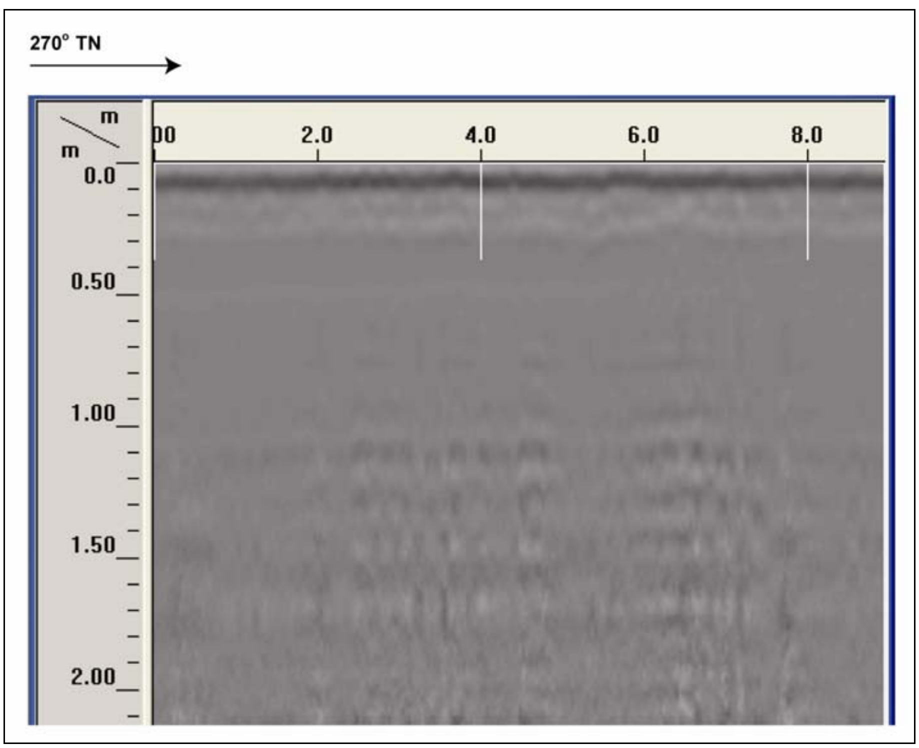

Figure 44. GPR Profile of East Kapolei P&R Test Trench 2

East Kapolei Station Test Trench 1

Orientation	226° TN
Length	8m
Width	0.7m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
I	0-160	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

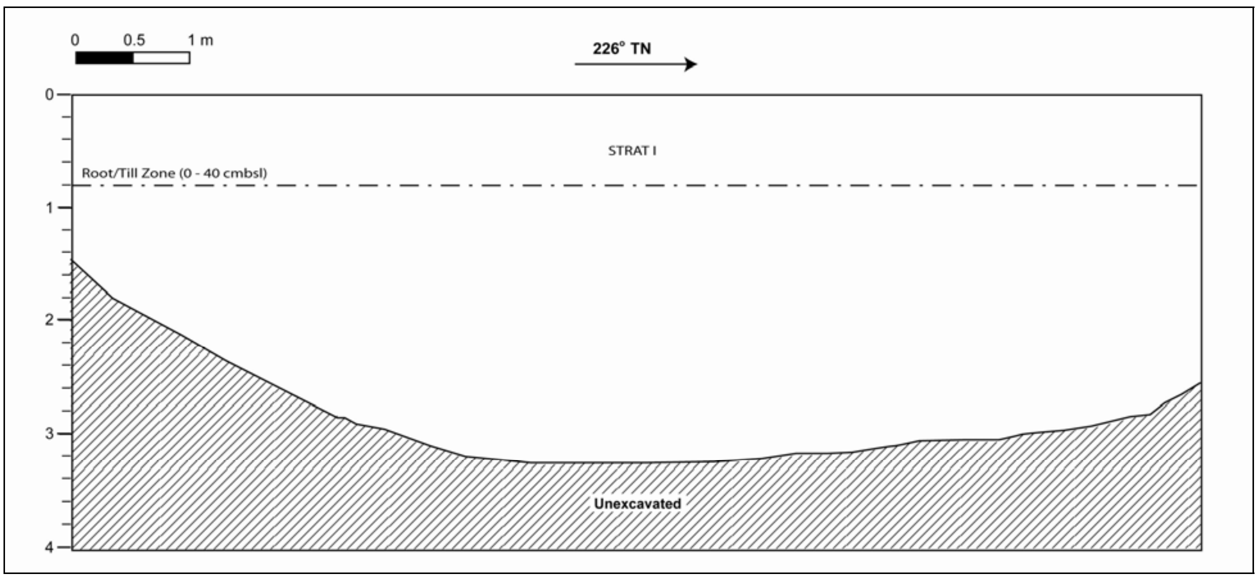

Figure 45. Profile of East Kapolei Station Test Trench 1

Figure 46. Photograph of East Kapolei Station Test Trench 1, view to east

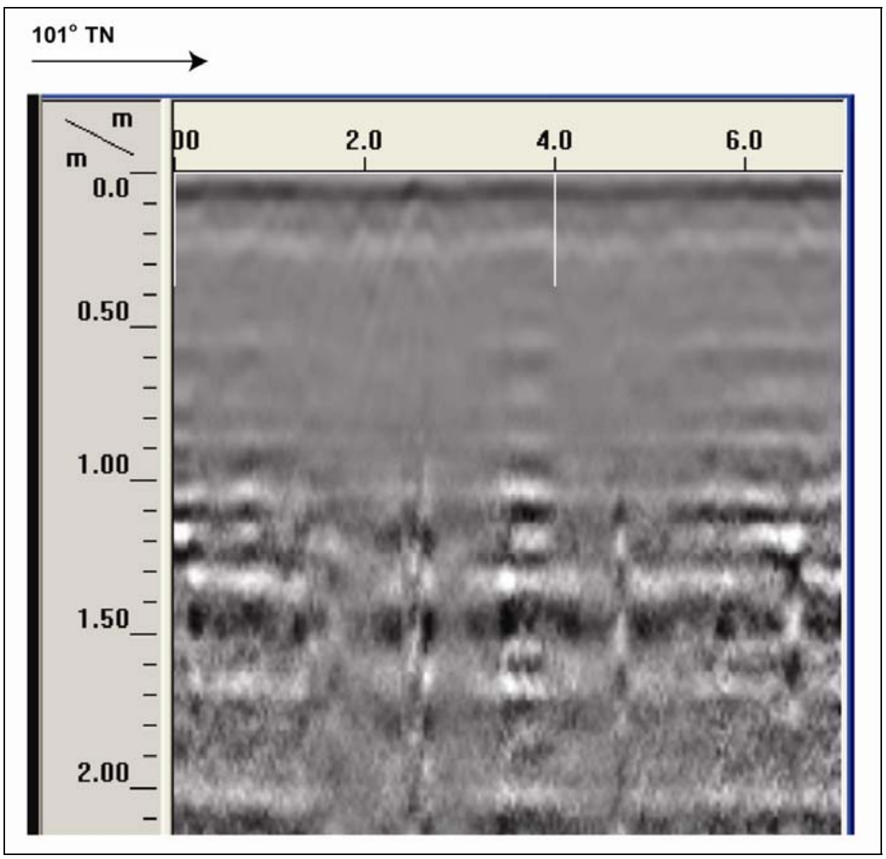

Figure 47. GPR Profile of East Kapolei Station Test Trench 1

East Kapolei Station Test Trench 2

Orientation	210° TN
Length	8m
Width	0.7m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
I	0-160	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

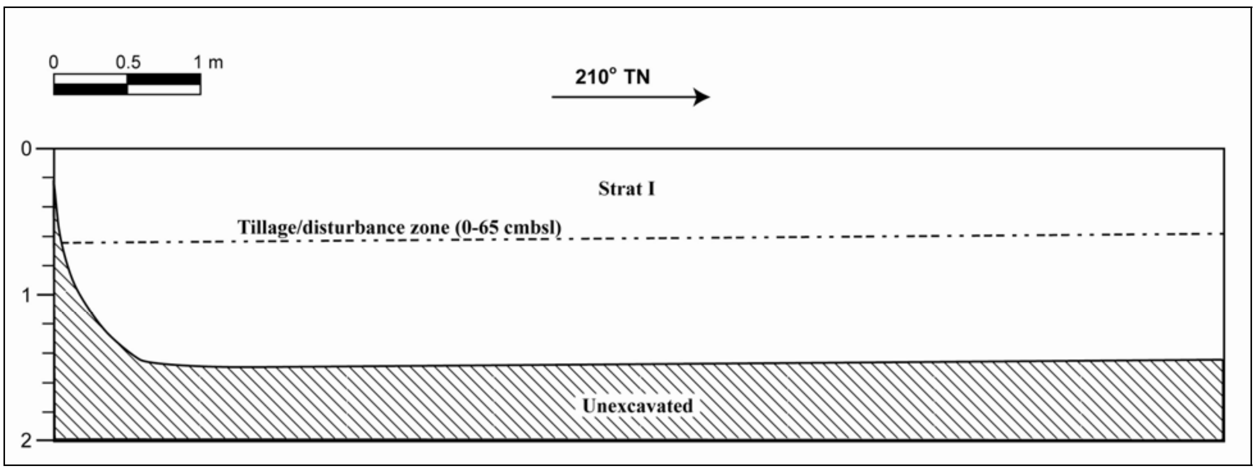

Figure 48. Profile of East Kapolei Station Test Trench 2

Figure 49. Photograph of East Kapolei Station Test Trench 2, view to east

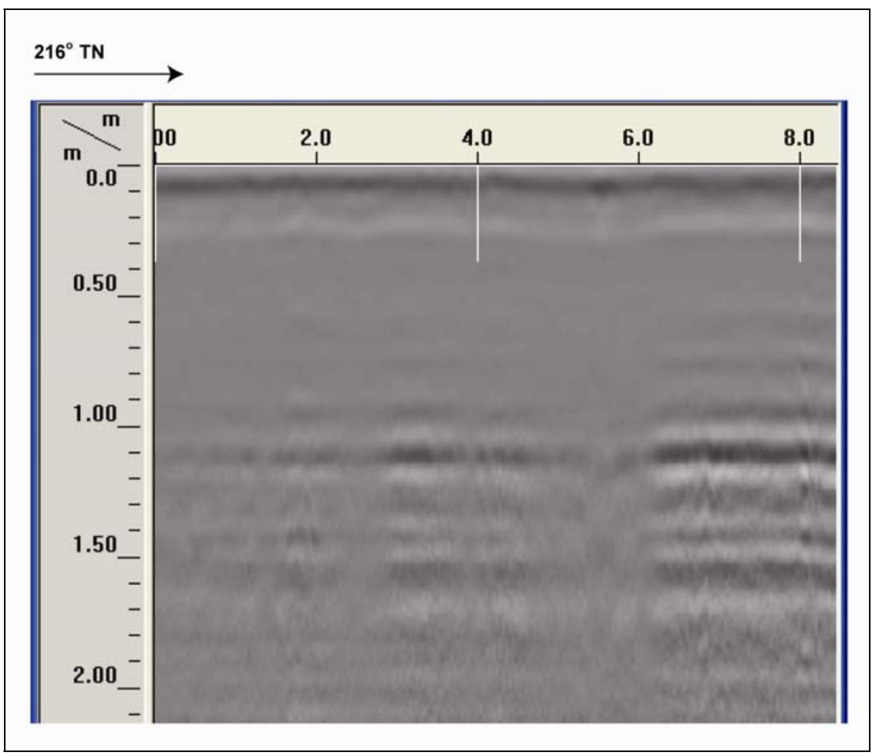

Figure 50. GPR Profile of East Kapolei Station Test Trench 2

Column Test 1 (C-1)

Orientation	11° TN
Length	3 m
Width	2 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
I	0-170	Fill; 7.5 YR 4/3, brown; silty clay loam; weak, coarse or thick, blocky structure; weakly coherant dry consistency; slightly plastic; no cementation; Previously disturbed naturally deposited alluvial sediment. Contains limestone and basalt cobbles, construction debris.

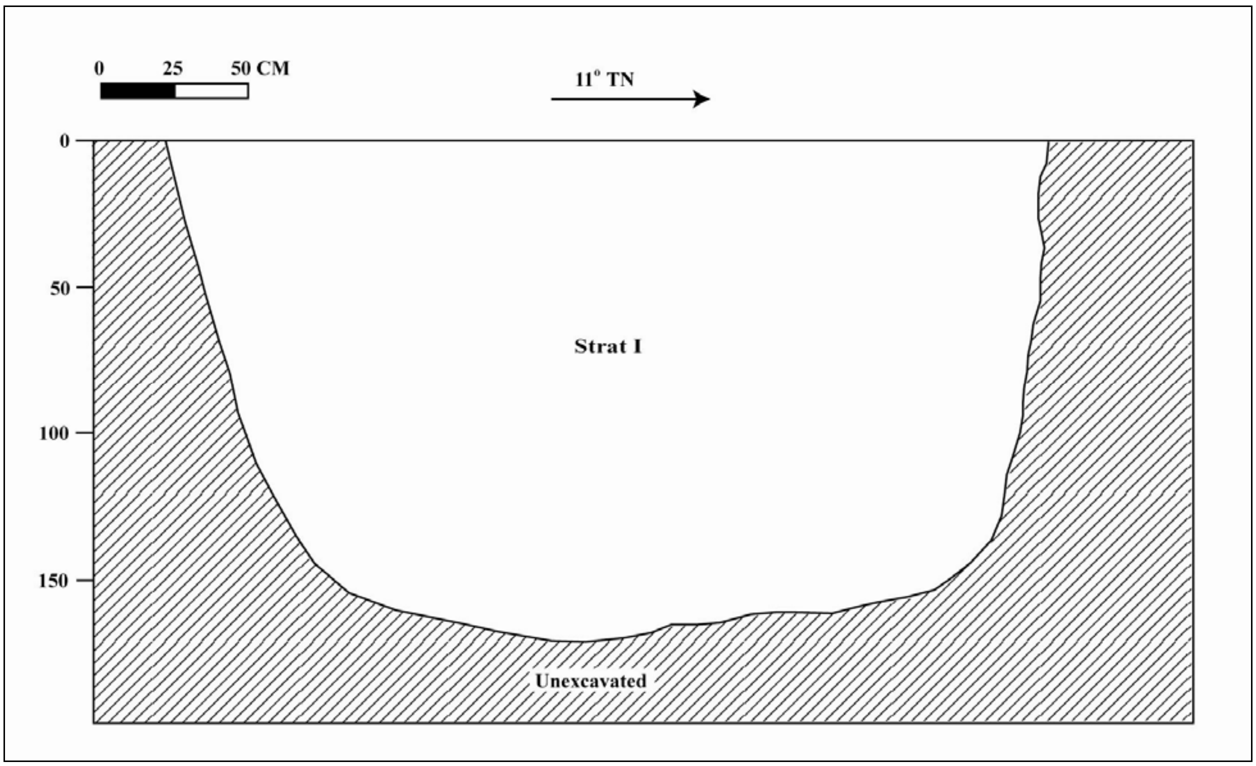

Figure 51. Profile of Column Test 1 (C-1)

Figure 52. Photograph of Column Test 1 (C-1), view to west

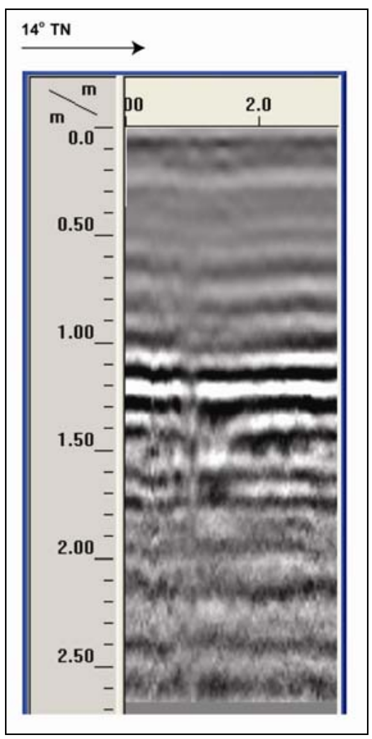

Figure 53. GPR profile of Column Test 1 (C-1)

4.2 Construction Sheet RW002

Construction Sheet RW002 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor, which is completely situated within actively cultivated agricultural land (Figure 54). One column test pit (C-2) was excavated within the area delineated by Construction Sheet RW002.

4.2.1 Pedestrian Inspection

As with the previous segment, this section of the project area has undergone extensive construction work for the new roadway (North-South Road) as well as a large drainage ditch (Figure 55). It was observed that road construction had altered the previous land surface elevation with the road surface being situated higher than the ground surface of the surrounding area. No cultural resources were observed.

4.2.2 GPR Survey

Prior to the excavation of column test pit 2 (C-2), the test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. This is due to the fact that the stratigraphy of C-2 consisted of a single uniform stratum containing no features or foreign objects (Figure 56 & Figure 57). As a result the coinciding GPR data was also fairly uniform, indicating no subsurface anomalies or stratigraphic layers present in the test area (Figure 58).

4.2.3 Subsurface Testing

4.2.3.1 Stratigraphic Summary

One (1) backhoe column test excavation was placed within the area delineated by Construction Sheet RW002 (see Figure 54). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding the excavated trench, please refer to the trench profile, sediment description, and photograph, which follow this more general summary discussion (Figure 56 to Figure 58).

In general the observed and documented stratigraphy consisted of a single stratum of previously disturbed naturally deposited alluvial sediment. The observed disturbance was associated with filling and grading actuivities of recent North - South Road construction. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

Figure 54. Construction Sheet RW002

Figure 55. Photo of current conditions along proposed rail route within Construction Sheet RW002, along side North-South Road

4.2.3.2 Excavation Documentation

Column Test 2 (C-2)

Orientation	177° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
I	0-170	Fill; 7.5 YR 4/3, brown; silty clay loam; weak, coarse or thick, blocky structure; weakly coherant dry consistency; slightly plastic; no cementation; Previously disturbed naturally deposited alluvial sediment. Disturbance associated with filling and grading actuivities of recent North - South Road construction.

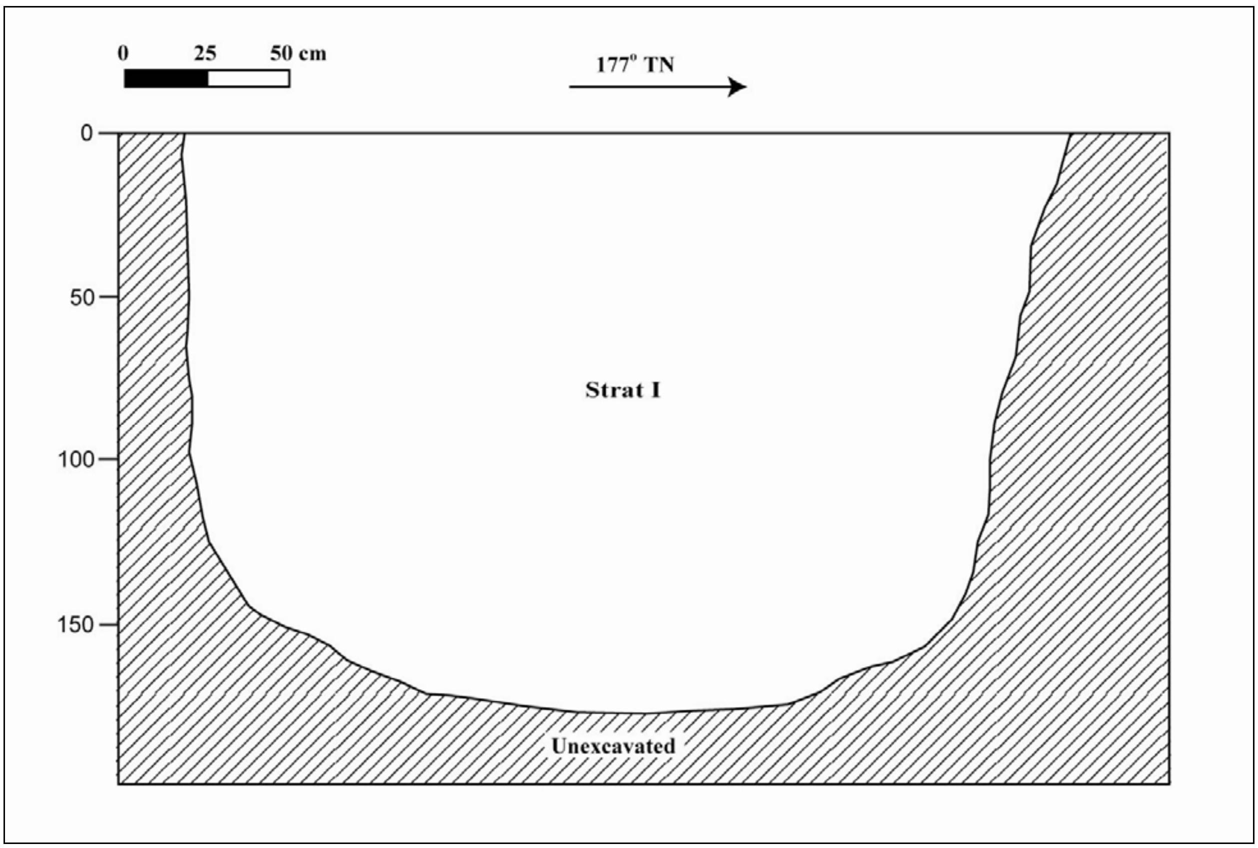

Figure 56. Profile of Column Test 2 (C-2)

Figure 57. Photograph of Column Test 2 (C-2), view to east

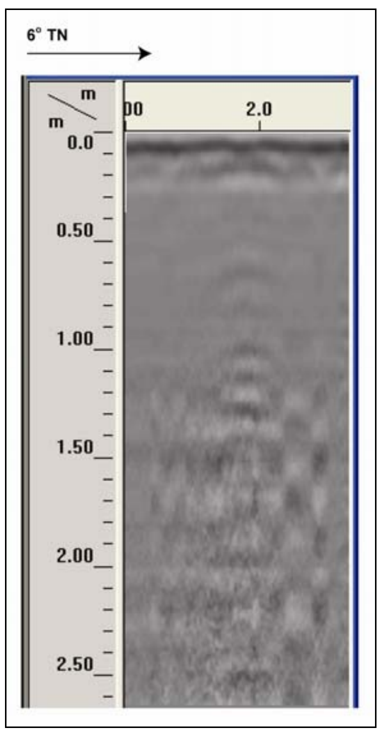

Figure 58. GPR profile of Column Test 2 (C-2)

4.3 Construction Sheet RW003

Construction Sheet RW003 consists of a 2,300 ft (0.7 km) segment of the proposed transit corridor and includes the proposed UH West Oʻahu Station and Park and Ride (P&R) (Figure 59 & Figure 60). Two test trenches were excavated at both the station and park and ride (see Figure 60). Additionally, one column test pit (C-3) was also excavated (see Figure 59), totaling 5 test excavations within Construction Sheet RW003.

4.3.1 Pedestrian Inspection

The UH West Oʻahu Station is located within the construction zone for North-South Road, while its two park and ride facilities are situated in agricultural fields currently cultivated by Aloun Farms (Figure 61). Both activities would have generated significant land disturbance to have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.3.2 GPR Survey

Prior to excavation, each test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, each test area was excavated to compare the results of the GPR survey with the observed stratigraphy. Figure 62 through Figure 75 consist of a stratigraphic profile, a photograph, and a GPR profile for each of the 5 test areas excavated within Construction Sheet RW003.

In general, the results of the GPR survey were inconclusive. This is due to the fact that the stratigraphy of all 5 test areas consisted of a single uniform stratum containing no features or foreign objects (Figure 62, Figure 65, Figure 67, Figure 70, & Figure 73). As a result the coinciding GPR data was also fairly uniform, indicating no subsurface anomalies or stratigraphic layers present in the test areas (Figure 64, Figure 69, Figure 72, & Figure 75).

4.3.3 Subsurface Testing

4.3.3.1 Stratigraphic Summary

Five (5) backhoe test units were placed within the area delineated by Construction Sheet RW003 (see Figure 59 & Figure 60). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated units, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 39 to Figure 53).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Of note was an area of disturbance ranging from 0 to 120 cmbs within all of the test excavations. This disturbance was determined to be associated with modern agriculture (i.e. tilling of the soil and irrigation line installation) as this

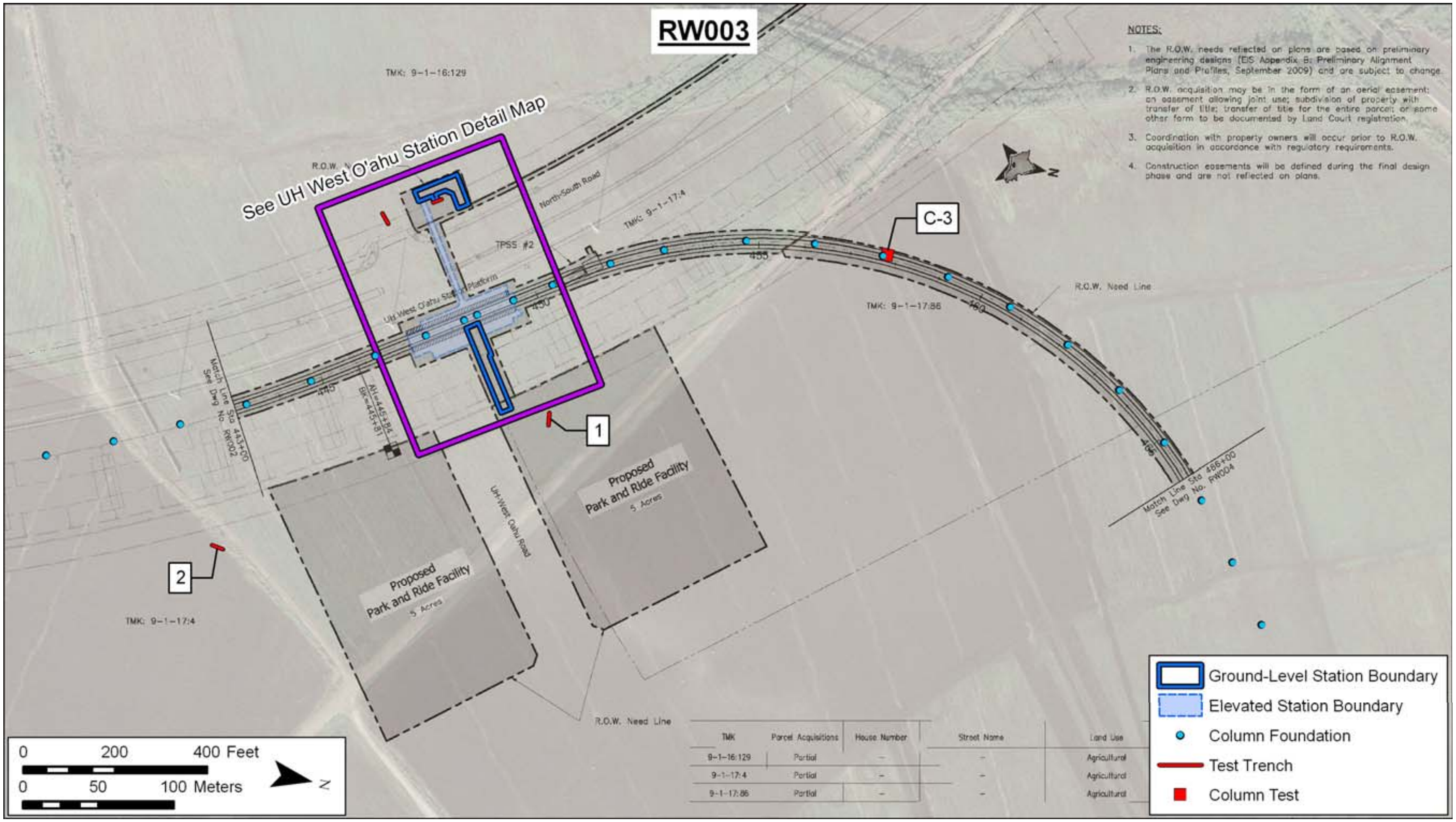

Figure 59. Construction Sheet RW003

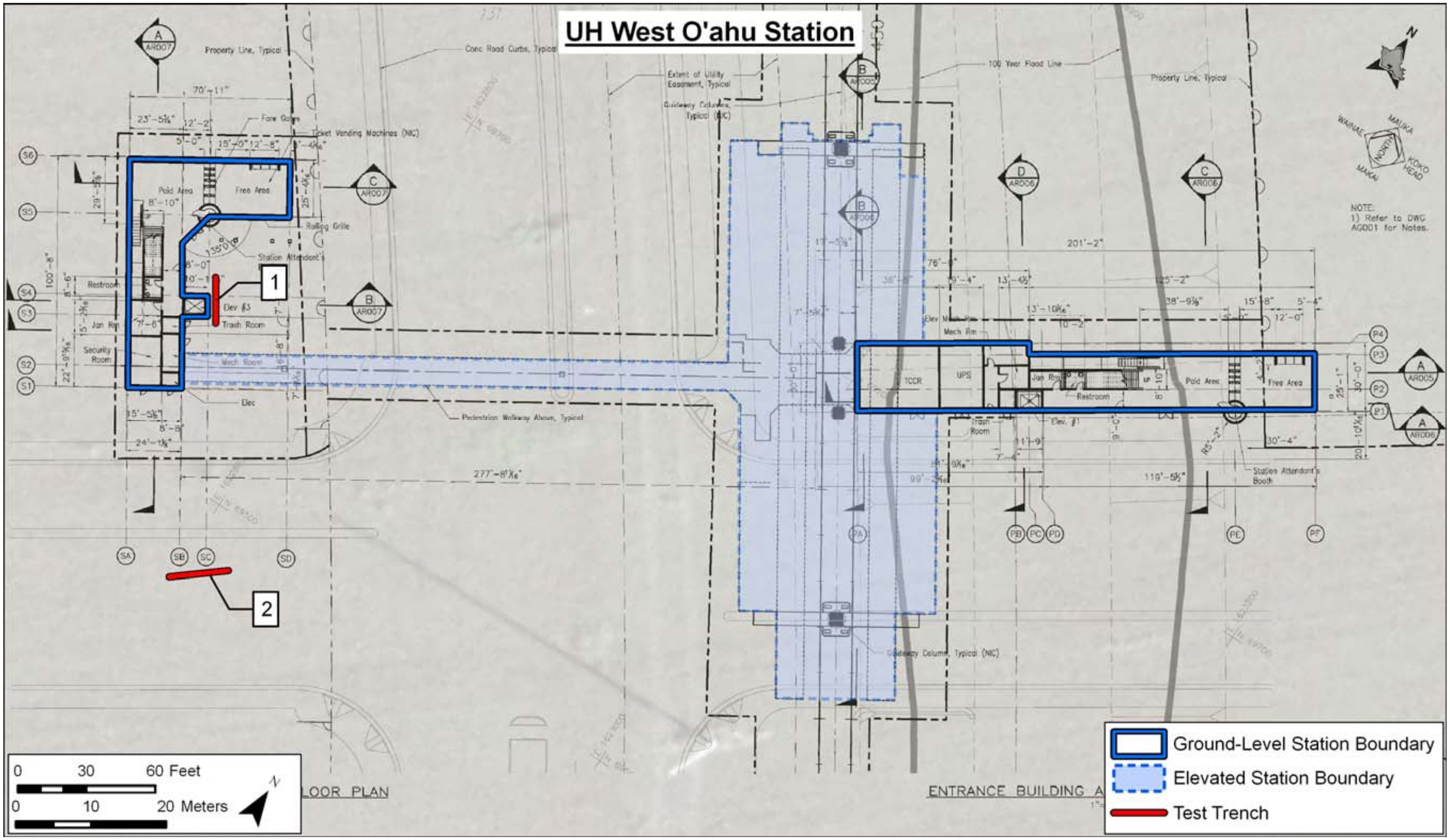

Figure 60. Floor Plan of UH West O‘ahu Station showing location of test trenches

Figure 61.Photo of current conditions at location for the UH West Oahu Park and Ride Facility along the west side of Aloun Farms showing active agricultural fields and access (dirt) roads

portion of the project area is situated within actively cultivated fields. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.3.3.2 Excavation Documentation

UH West Oahu Station Test Trench 1

Orientation	337° TN
Length	8m
Width	0.7m
Maximum Depth	1.7m

Stratum	Depth (cmbs)	Description
I	0-170	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

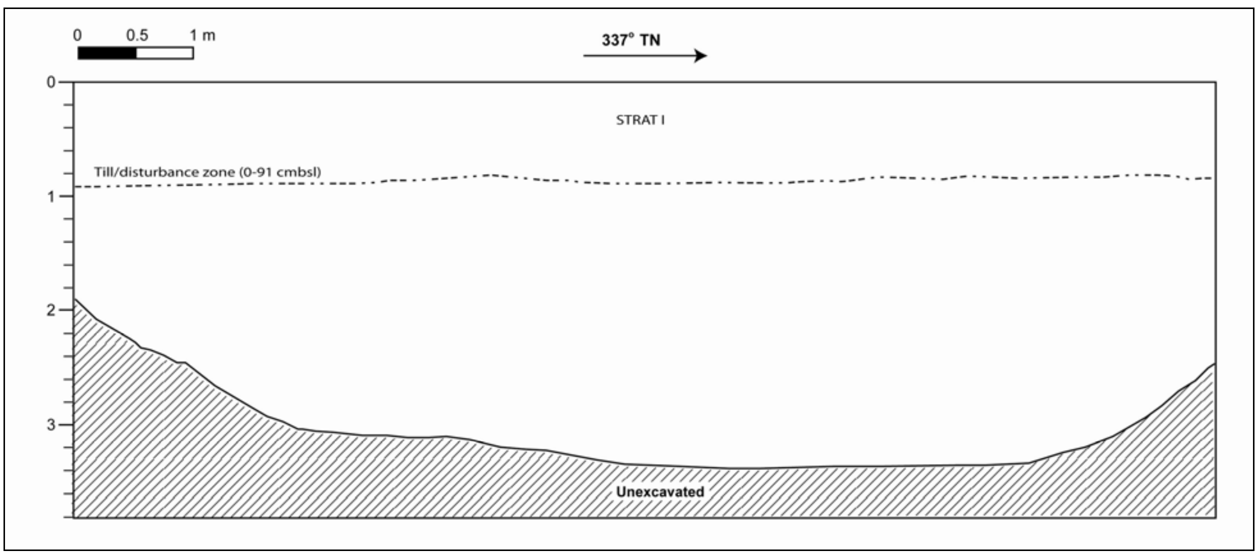

Figure 62. Profile of UH West Oahu Station Test Trench 1

Figure 63. Photograph of UH West Oahu Station Test Trench 1, view to west

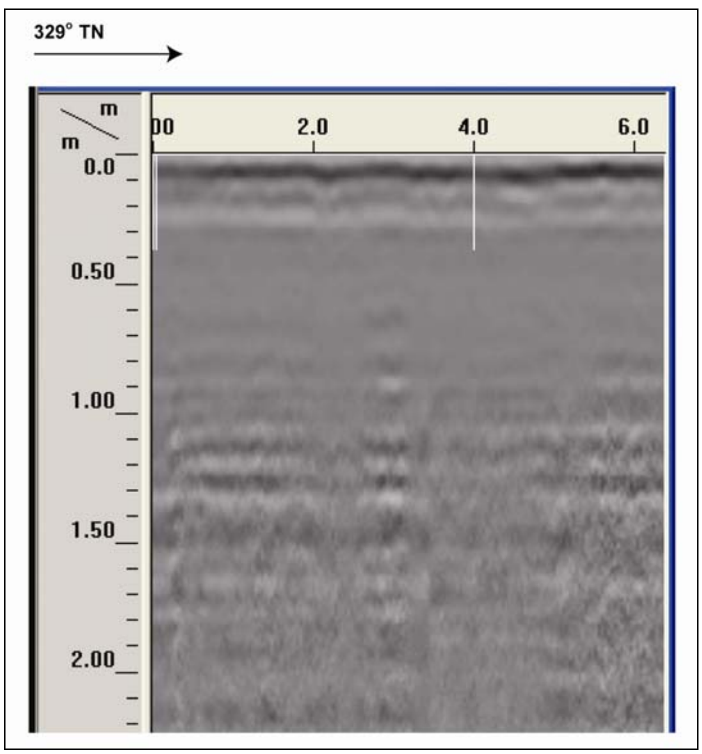

Figure 64. GPR profile of UH West Oahu Station Test Trench 1

UH West Oahu Station Test Trench 2

Orientation	239° TN
Length	8m
Width	0.7m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 105 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

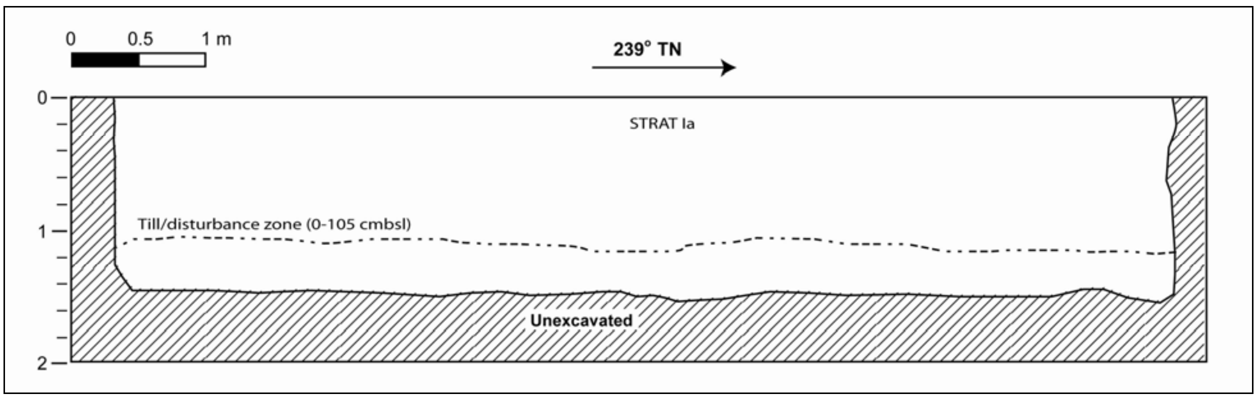

Figure 65. Profile of UH West Oahu Station Test Trench 2

Figure 66. Photograph of UH West Oahu Station Test Trench 2, view to south

UH West Oahu P&R Test Trench 1

Orientation	265° TN
Length	8m
Width	0.7m
Maximum Depth	1.4 m

Stratum	Depth (cmbs)	Description
I	0-140	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 80 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

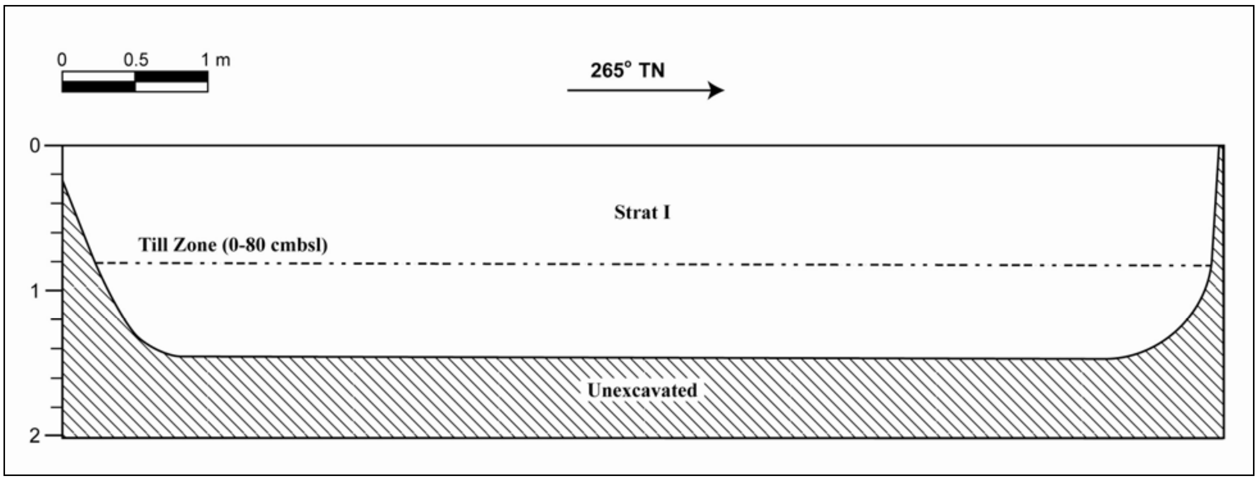

Figure 67. Profile of UH West Oahu P&R Test Trench 1

Figure 68. Photograph of UH West Oahu P&R Test Trench 1, view to south

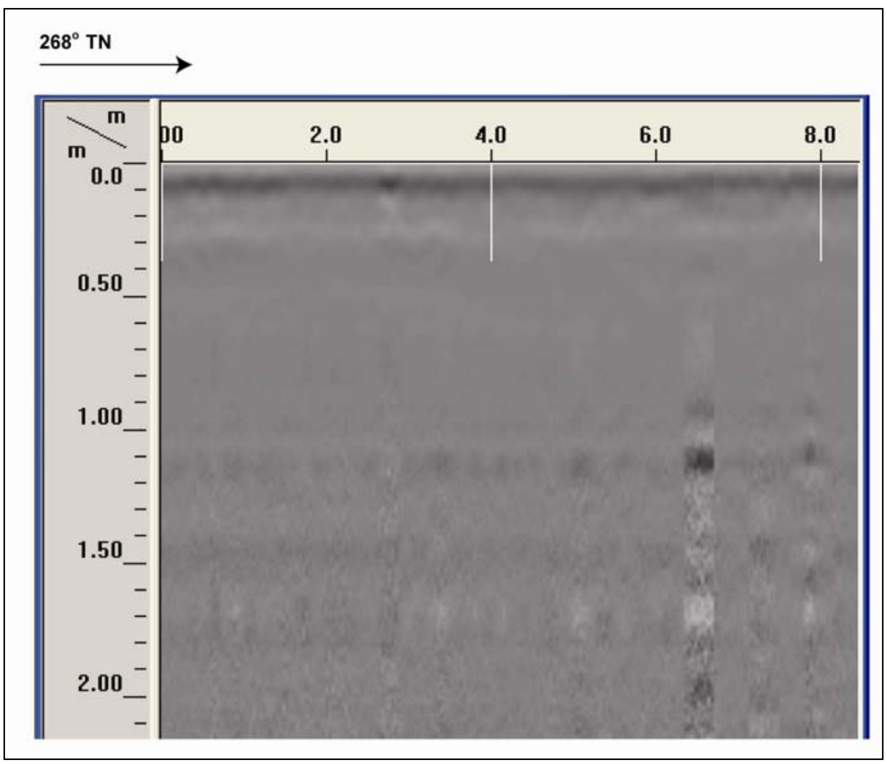

Figure 69. GPR profile of UH West Oahu P&R Test Trench 1

UH West Oahu P&R Test Trench 2

Orientation	009° TN
Length	8 m
Width	0.7 m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
I	0-160	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 120 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

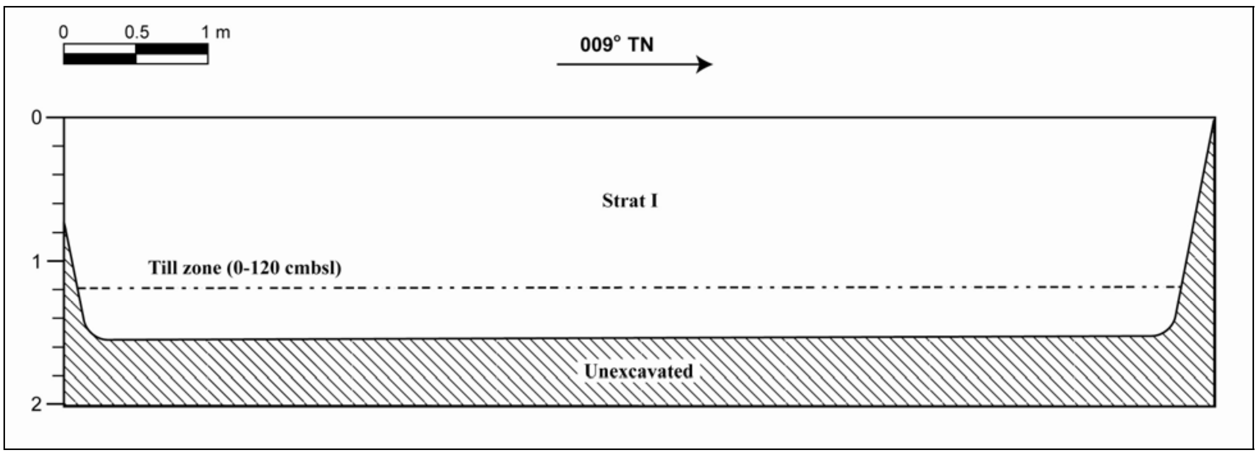

Figure 70. Profile of UH West Oahu P&R Test Trench 2

Figure 71. Photograph of UH West Oahu P&R Test Trench 2, view to west

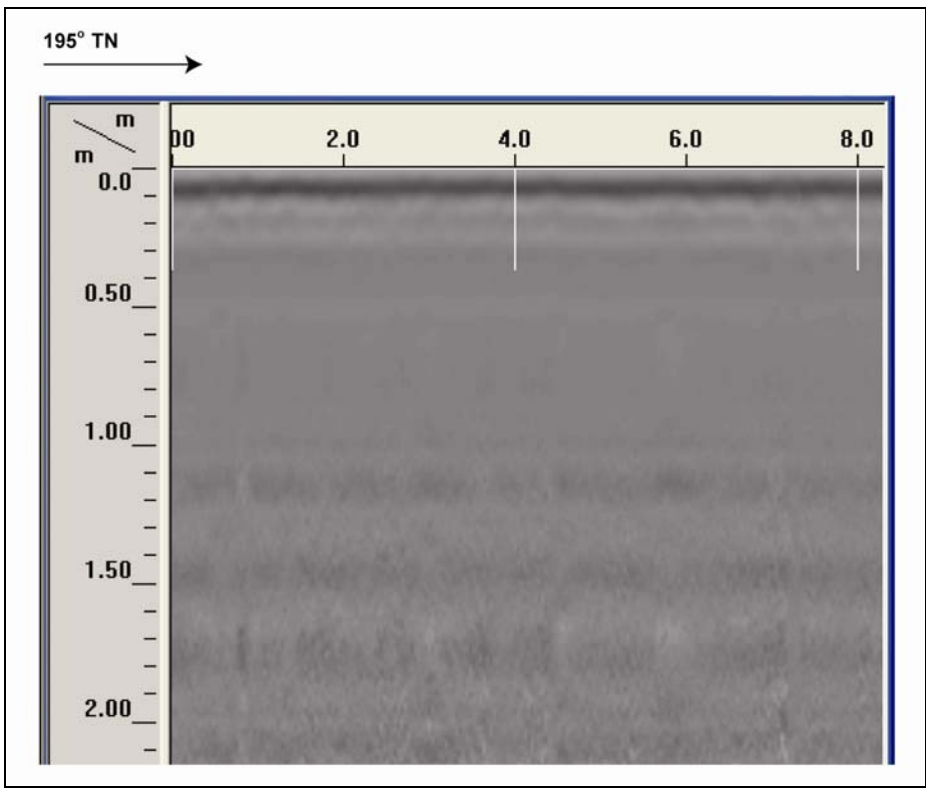

Figure 72. GPR profile of UH West Oahu P&R Test Trench 2

Column Test 3 (C-3)

Orientation	236° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.45 m

Stratum	Depth (cmbs)	Description
I	0-145	7.5 YR 3/3, dark brown; clay loam; moderate, coarse or thick, blocky structure; weakly coherant dry consistency; plastic; no cementation; Alluvial sediments utilized for agricultural fields - till zone 40 cmbs.

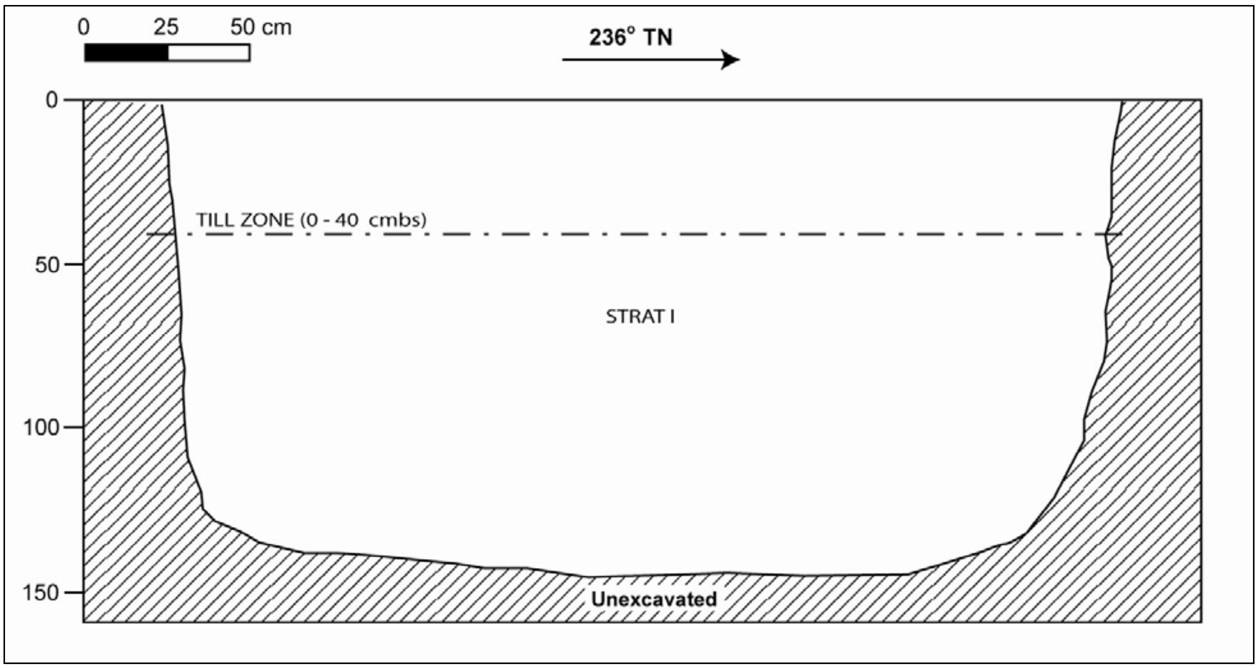

Figure 73. Profile of Column Test 3 (C-3)

Figure 74. Photograph of Column Test 3 (C-3), view to southeast

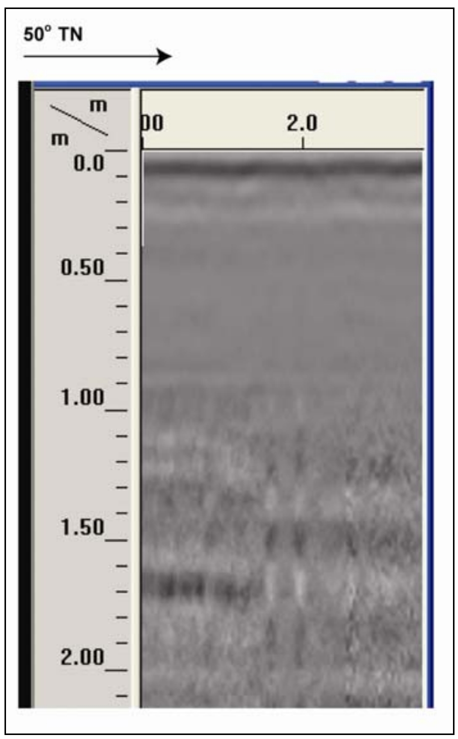

Figure 75. GPR profile of Column Test 3 (C-3)

4.4 Construction Sheet RW004

Construction Sheet RW004 consists of a 2,300 ft (0.7 km) segment of the proposed transit corridor (Figure 76). One column test pit (C-16) was excavated within Construction Sheet RW004.

4.4.1 Pedestrian Inspection

This section of the project area is actively being used for intensified agriculture by Aloun Farms (Figure 77). The proposed transit route crosses three fields within Construction Sheet RW004. A wide assortment of cultigens was planted in each field with each type switched after crops were harvested and the field re-tilled. No cultural resources were observed within this section of the project area.

4.4.2 GPR Survey

Prior to the excavation of column test pit 16 (C-16), the test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey appears to have identified the stratigraphic interface between Stratum I and Stratum II within column test pit 16 (C-16) (Figure 78). The horizontal banding shown from 0 to 30 cmbs in the GPR profile seems to correspond to the crushed coral fill layer (Stratum I) observed during excavation (Figure 80). It is believed that the drastic variance in consistency and compaction between the coral fill and the underlying clay loam allowed the GPR to delineate the stratigraphic interface between them.

4.4.3 Subsurface Testing

4.4.3.1 Stratigraphic Summary

One (1) backhoe test excavation was placed within the area delineated by Construction Sheet RW004 (see Figure 76). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding the excavated trench, please refer to the trench profile, sediment description, and photograph, which follow this more general summary discussion (Figure 78 to Figure 80).

In general the observed and documented stratigraphy consisted of a crushed coral road surface overlying a single stratum of naturally deposited alluvial sediment utilized for agriculture. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

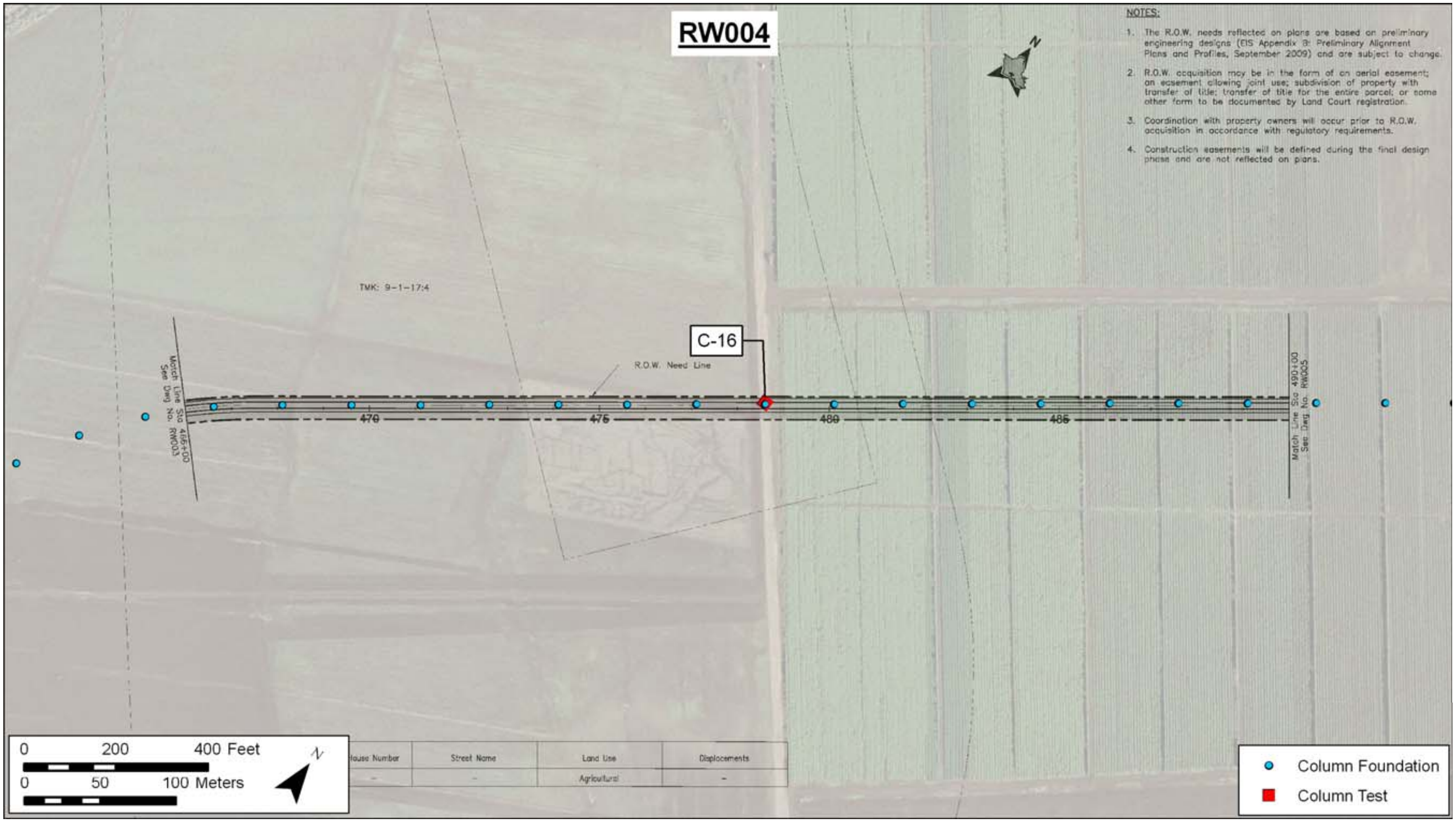

Figure 76. Construction Sheet RW004 showing the location of test excavations

Figure 77. Photo of active agricultural fields and access roads within Aloun Farms where transit route is projected to extend

4.4.3.2 Excavation Documentation

Column Test 16 (C-16)

Orientation	220° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.45 m

Stratum	Depth (cmbs)	Description
I	0-30	Crushed coral road surface
II	30-145	7.5 YR 3/3, dark brown; clay loam; moderate, coarse or thick, blocky structure; weakly coherant dry consistency; plastic; no cementation; Naturally deposited alluvial sediment.

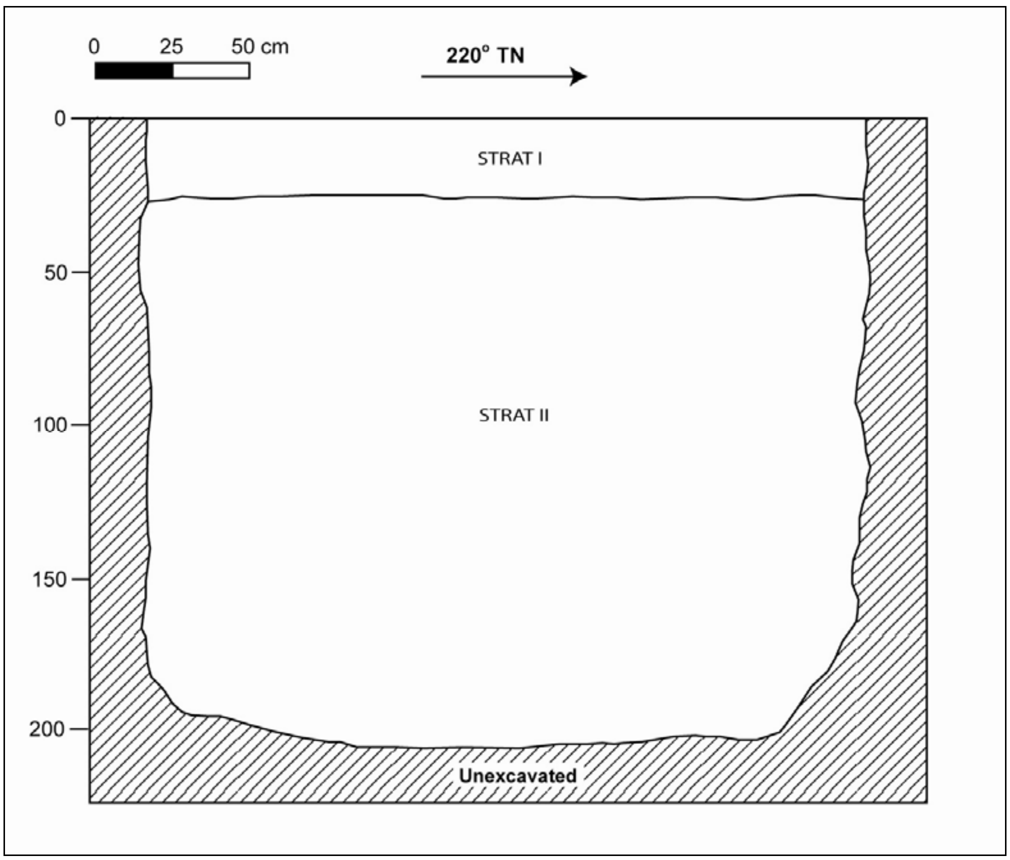

Figure 78. Profile of Column Test 16 (C-16)

Figure 79. Photograph of Column Test 16 (C-16), view to southeast

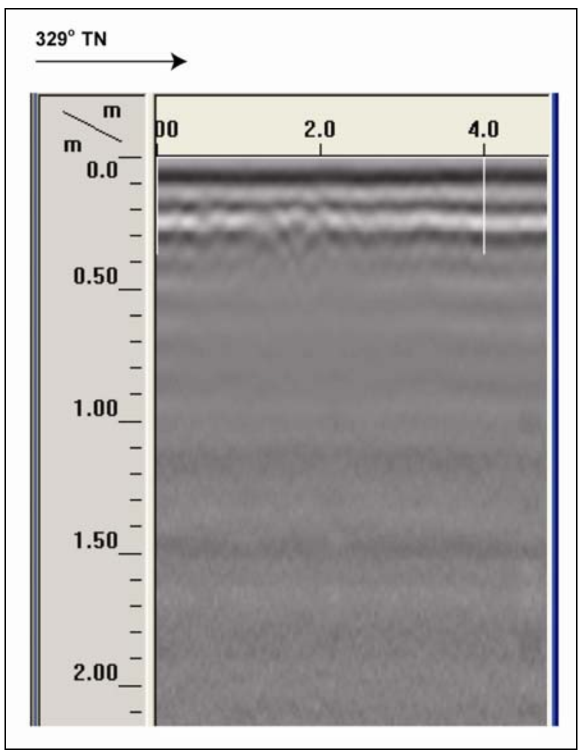

Figure 80. GPR profile of Column Test 16 (C-16)

4.5 Construction Sheet RW005

Construction Sheet RW005 consists of a 2,300 ft (0.7 km) segment of the proposed transit corridor and includes the proposed Ho`opili Station (Figure 81). Two test trenches were excavated at the station, as well as two column test pits (C-15 and C-19), totaling 4 test excavations within Construction Sheet RW005.

4.5.1 Pedestrian Inspection

This segment of the project area lies entirely within the actively cultivated fields and dirt access roads of Aloun Farms (Figure 82). Modern and historic agricultural activities in this area would have removed any surface cultural resources that may have been present. No cultural resources were observed within this section of the project area.

4.5.2 GPR Survey

Prior to the excavation, each test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, each test area was excavated to compare the results of the GPR survey with the observed stratigraphy. Figure 83 through Figure 94 consist of a stratigraphic profile, a photograph, and a GPR profile for each of the 4 test areas excavated within Construction Sheet RW005.

The GPR survey of this area had mixed results. The GPR survey of Ho`opili Station Test Trench 1 was unable to identify a concentration of basalt boulders which were located approximately 30 cm below the surface (Figure 83 & Figure 85). However, during the GPR survey of Column Test 19, a water main and associated subsurface disturbance (i.e. prior trenching) were identified through the presence of subsurface anomalies within the GPR profile. Thus the question arises: What could cause such varying results in this area, given what appears to be fairly uniform environmental conditions? Upon further investigation, two major varying factors arise: 1.) topography and 2.) soil chemistry.

Uneven surface topography (both at ground level and buried) can cause a phenomenon known as radar scatter. Radar reflections off of surfaces "that contain ridges or troughs, or any other irregular features, can either focus or scatter radar energy, depending on the surface's orientation and the location of the antenna on the ground surface" (Conyers 2004: 73). The ground surface at Ho`opili Station Test Trench 1 is slightly sloped and was recently tilled prior to the GPR survey, causing an uneven surface with ridges and troughs. Additionally, the subsurface concentration of basalt boulders formed another uneven surface with ridges and troughs (see Figure 83). It is believed that these two irregular surfaces functioned as reflective planes diverting the emitted radar energy away from the GPR antenna, resulting in a severely attenuated GPR signal. Thus resulting in the complete absence of the large basalt boulders in the GPR profile. In contrast, the land surface at Column Test 19 consisted of a level crushed coral road surface, which did not interfere with the propagation and collection of the radar, thus resulting in an accurate location of subsurface features.

Figure 81. Construction Sheet RW005 showing the location of test excavations

Figure 82.Photo of location for Ho‘opili Station within the Aloun Farms agricultural fields area

Soil chemistry is another factor that likely contributed to the conflicting GPR readings at Ho`opili Station Test Trench 1 and Column Test 19. As Conyers (2004) notes, agricultural soils, usually saturated with nitrogen and potassium, are highly conductive, causing radio transmissions to dissipate and resulting in radio wave attenuation at shallow depths. As mentioned above, the land surface at Ho`opili Station Test Trench 1 was recently tilled, and was likely in active cultivation for decades causing a build up of conductive chemicals in the soil, likely obscuring the presence of the basalt boulders in the GPR profile. Conversely, Column Test 19 was located within a road, not actively cultivated, and probably had a significantly lower concentration of conductive chemicals, thus resulting in an accurate location of subsurface features.

4.5.3 Subsurface Testing

4.5.3.1 Stratigraphic Summary

Four (4) test excavations were placed within the area delineated by Construction Sheet RW005 (see Figure 81). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 83 to Figure 94).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for modern agriculture. Of note are Ho`opili Station Test Trench 1 and Column Test 19, both of these test excavation deviated from the norm. The stratigraphy of Ho`opili Station Test Trench 1 consisted of two varying fill layers, a clay loam from the local area and a layer of basalt rock and boulders (Figure 83 & Figure 84). As this test excavation was located within a recently tilled agricultural field, it is believed that the layer of basal rocks is related to agricultural activities, possibly related to drainage for a particular crop.

The stratigraphy of Column Test 19 also consisted two varying fill layers, a crushed coral road surface overlying a clay loam fill associated with the installation of a water main (Figure 92 & Figure 93).

All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.5.3.2 Excavation Documentation

Ho`opili Station Test Trench 1

Orientation	238° TN
Length	6m
Width	0.7m
Maximum Depth	1.14m

Stratum	Depth (cmbs)	Description
Ia	0-70	Fill; 5 YR 3/3, dark reddish brown; clay loam; moderate, fine, crumb structure; loose dry consistency; non-plastic; no cementation; very abrupt wavy lower boundary; Agricultural soil
Ib	32-114	Fill; 10 YR 5/1, gray; basalt cobbles; structureless, loose dry consistency; non-plastic; no cementation; Layer of bulldozer push forming berm

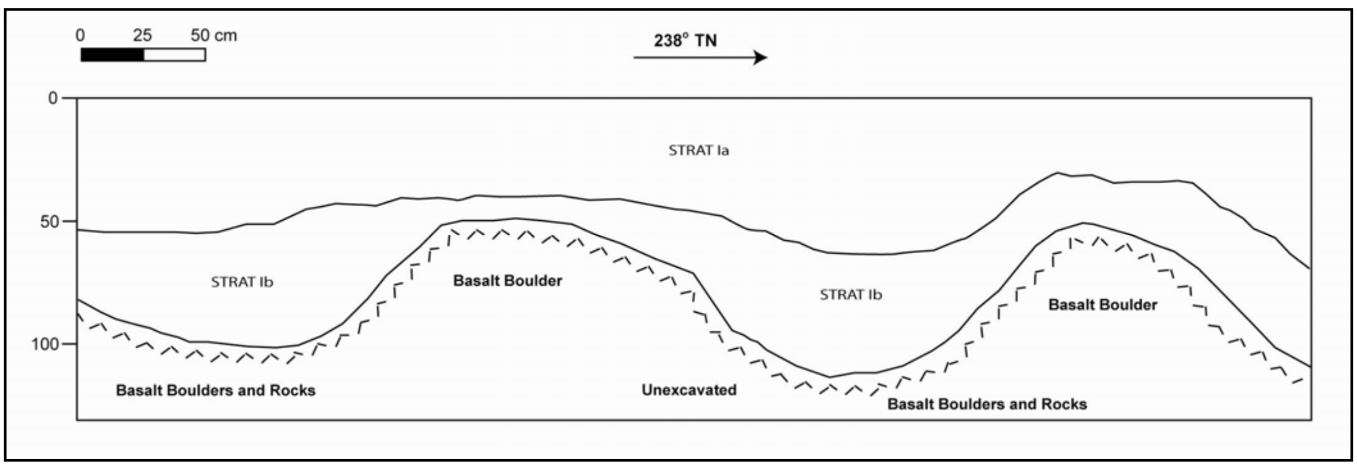

Figure 83. Profile of Ho`opili Station Test Trench 1

Figure 84. Photograph of Ho`opili Station Test Trench 1, view to southeast

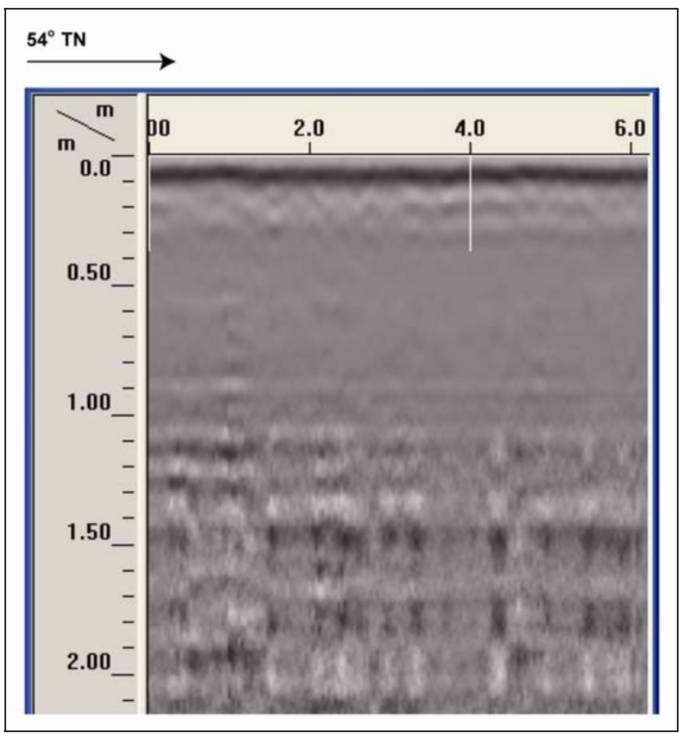

Figure 85. GPR profile of Ho`opili Station Test Trench 1

Ho`opili Station Test Trench 2

Orientation	229° TN
Length	6m
Width	0.7m
Maximum Depth	2m

Stratum	Depth (cmbs)	Description
I	0-20	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil and instiullation of water lines).

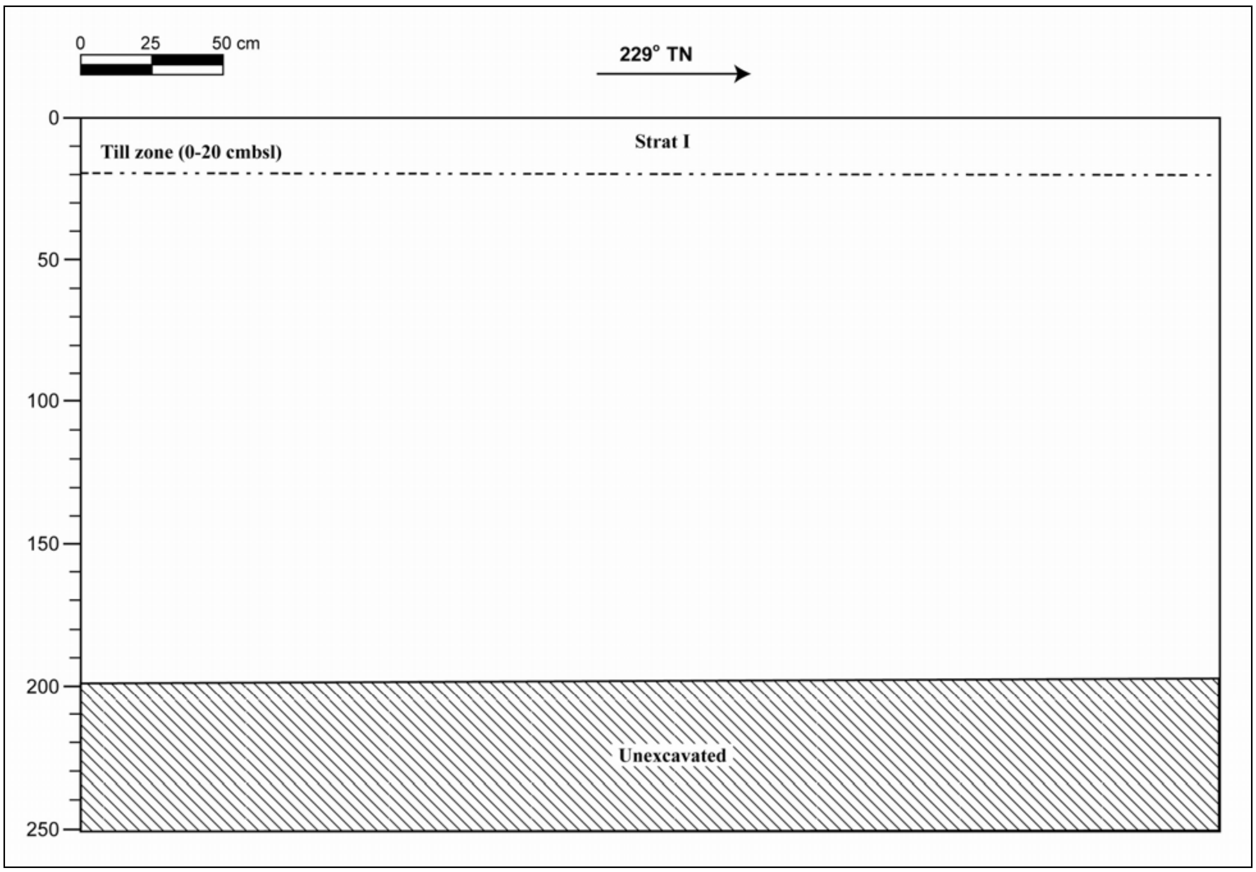

Figure 86. Profile of Ho`opili Station Test Trench 2

Figure 87. Photograph of Ho`opili Station Test Trench 2, view to northeast

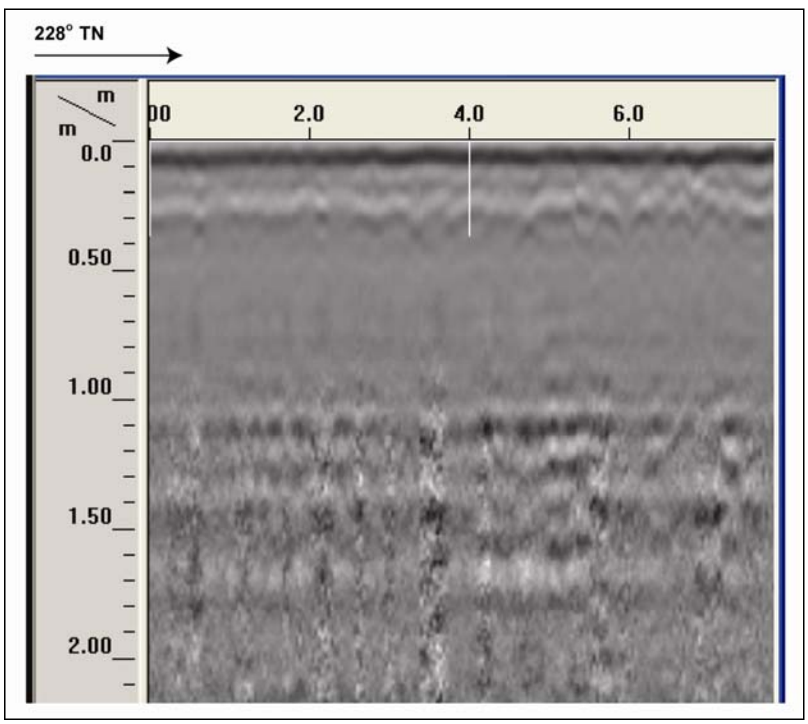

Figure 88. GPR profile of Ho`opili Station Test Trench 2

Column Test 15 (C-15)

Orientation	315° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
I	0-170	10 YR 4/2, dark grayish brown; clay; moderate, fine, crumb structure; slightly hard dry consistency; friable moist consistency; sticky wet consistency; slightly plastic; no cementation; Natural alluvial clay utilized for agriculture fields - top tilled slightly compacted from crop growing

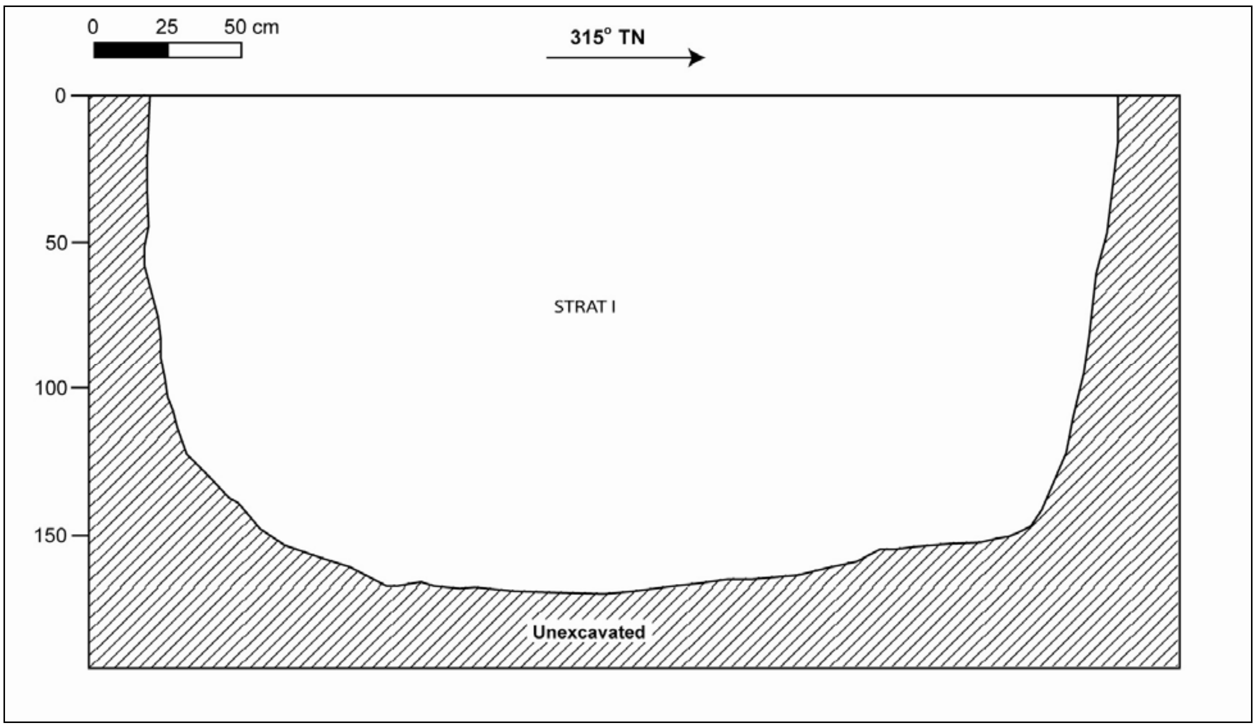

Figure 89. Profile of Column Test 15 (C-15)

Figure 90. Photograph of Column Test 15 (C-15), view to southwest

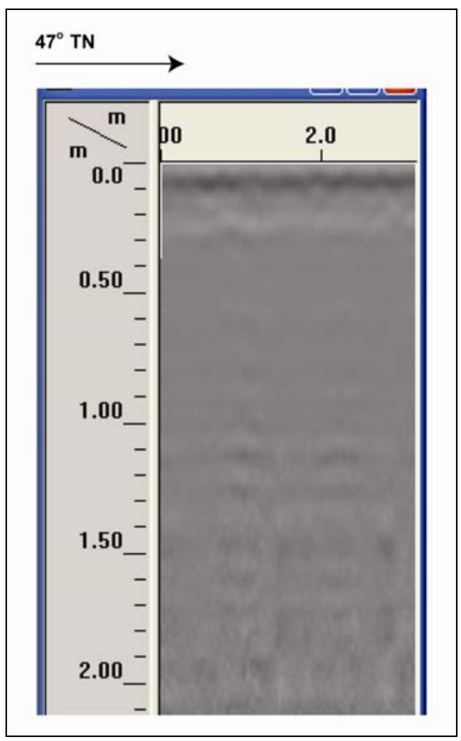

Figure 91. GPR profile of Column Test 15 (C-15)

Column Test 19 (C-19)

Orientation	80° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.2 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Crushed coral fill
Ib	50-120	Fill; 10 YR 4/2, dark grayish brown; clay loam; moderate, medium, grandular structure; moist, firable consistency; sticky wet consistency; slightly plastic; no cementation; terrestrial origin. Fill over top of water main.

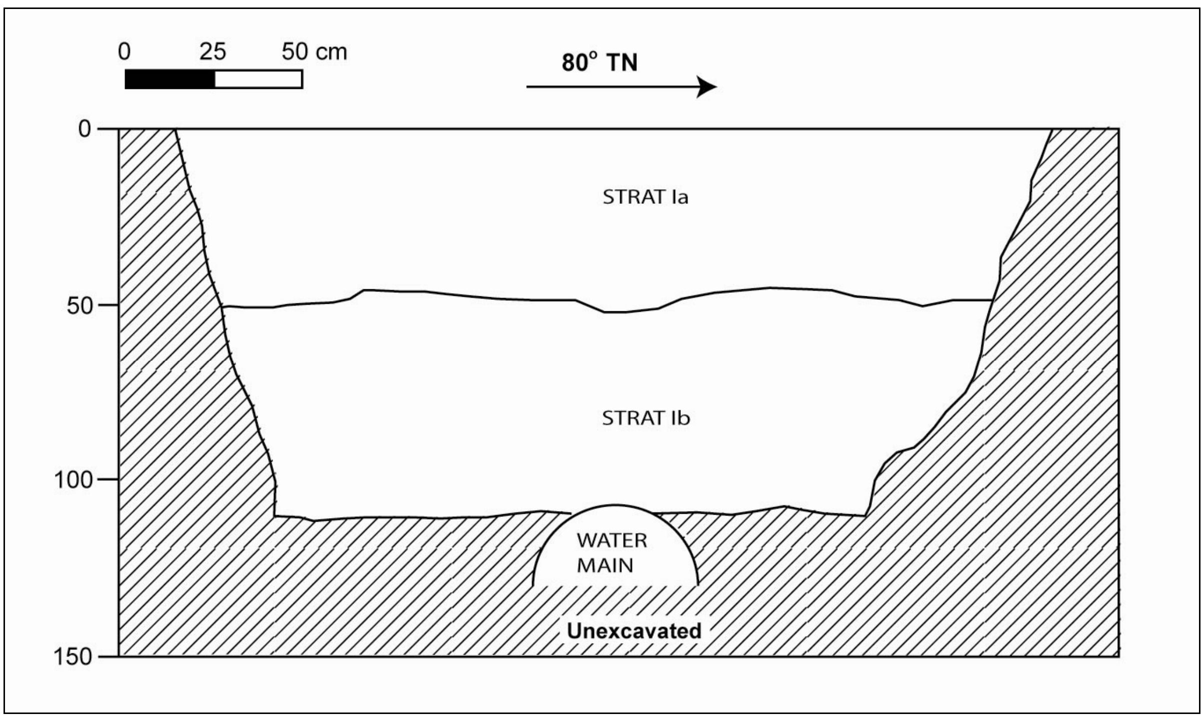

Figure 92. Profile of Column Test 19 (C-19)

Figure 93. Photograph of Column Test 19 (C-19), view to north

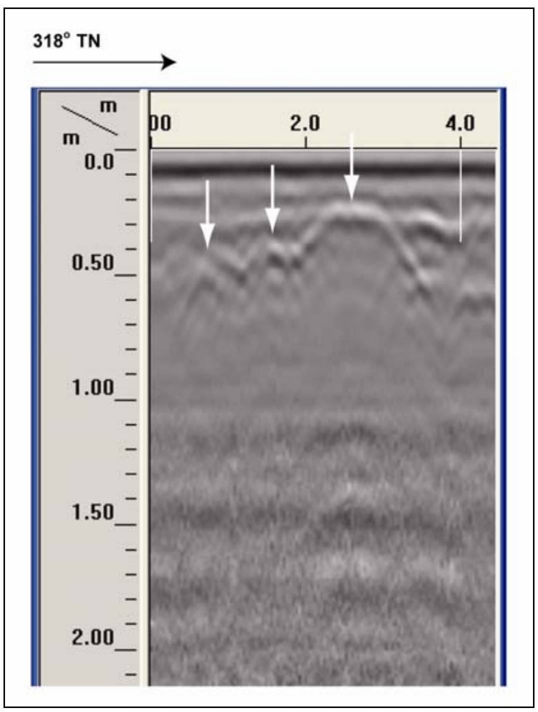

Figure 94. GPR profile of Column Test 19 (C-19) (note: Subsurface anomalies marked with white arrows)

4.6 Construction Sheet RW006

Construction Sheet RW006 consists of a 2,700 ft (0.8 km) segment of the proposed transit corridor (Figure 95). Two column test pits (C-17 & C-18) were excavated within Construction Sheet RW006.

4.6.1 Pedestrian Inspection

This section of the project area transitions from actively cultivated agricultural fields to the Farrington Highway Right of Way, defined by asphalt paved roadways with associated drainage ditches (Figure 96 & Figure 97). Both agricultural and road construction activities would have generated significant land disturbance to have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.6.2 GPR Survey

Prior to the excavation of column test pit 17 (C-17) and 18 (C-18), the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey appears to have identified the stratigraphic interface between the agricultural till zone (Stratum I) and the underlying culturally sterile alluvial sediments (Stratum II) within column test pits 17 (C-17) and 18 (C-18) (Figure 98 & Figure 101). The subtle horizontal banding shown from 0 to 30 cmbs in the GPR profiles seems to correspond to the agricultural till zone (Stratum I) observed during excavation (Figure 100 & Figure 103). It is believed that the variance in consistency and compaction between Stratum I and Stratum II allowed the GPR to delineate the stratigraphic interface between them.

4.6.3 Subsurface Testing

4.6.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW006 (see Figure 95). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the test units, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 98 to Figure 103).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Of note was an area of disturbance ranging from 0 to 100 cmbs within the test excavations. This disturbance was determined to be associated with modern agriculture (i.e. tilling of the soil and irrigation line installation) as this portion of the project area is situated within actively cultivated fields. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were

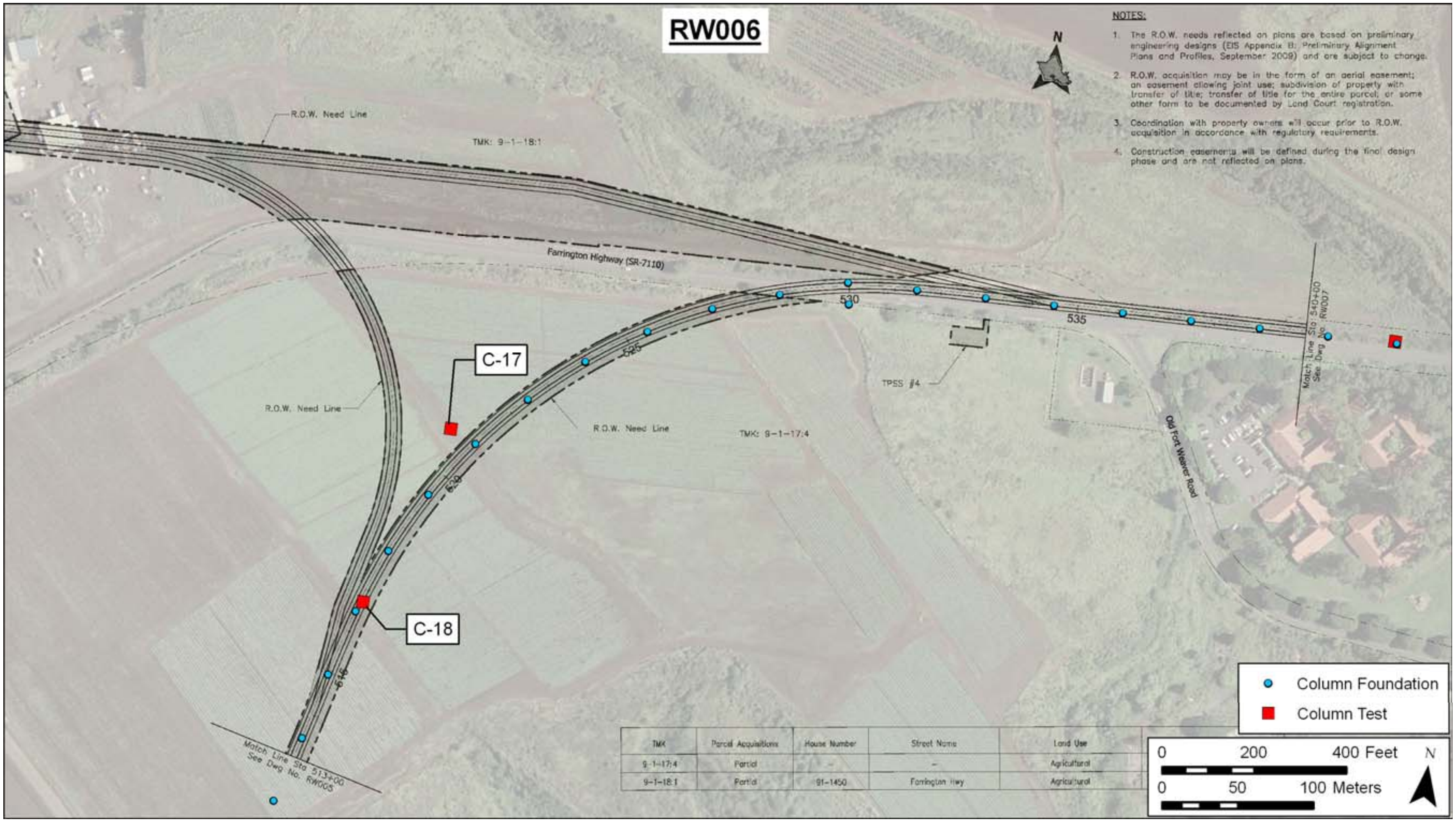

Figure 95. Construction Sheet RW006 showing location of test excavations

Figure 96. Photograph of Aloun Farms agricultural fields along proposed transit route prior to it adjoining Farrington Highway

Figure 97. Photograph of approximate location where proposed transit route will transition from agricultural fields to run alongside Farrington Highway

backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.6.3.2 Excavation Documentation

Column Test 17 (C-17)

Orientation	93° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
I	0-200	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 50 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

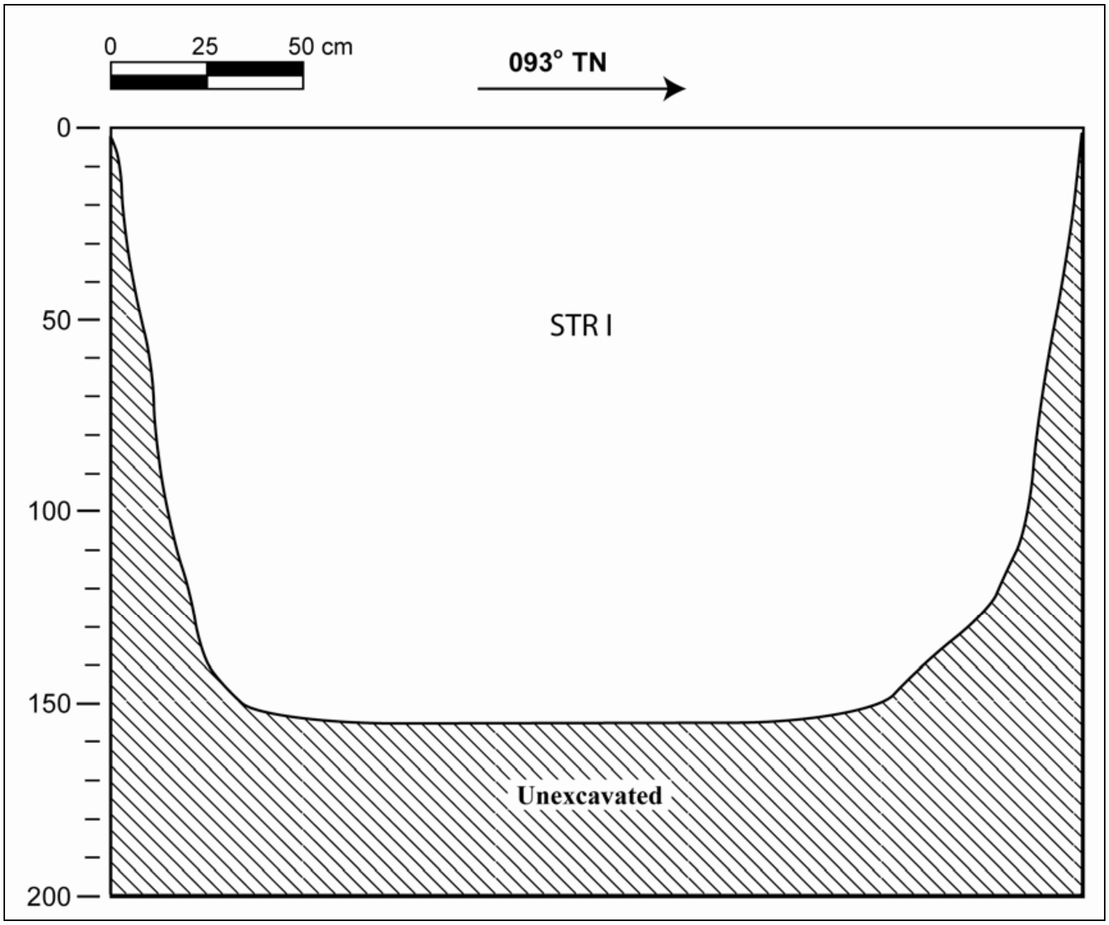

Figure 98. Profile of Column Test 17 (C-17)

Figure 99. Photograph of Column Test 17 (C-17), view to north

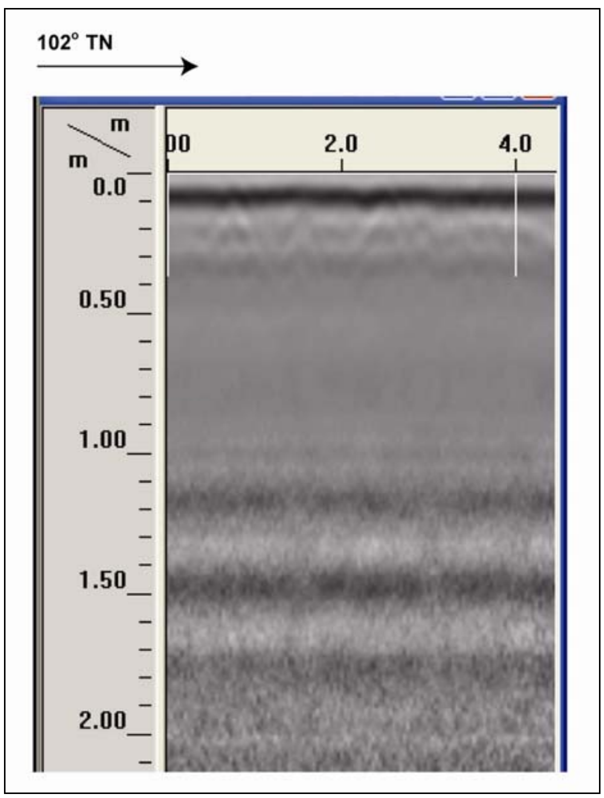

Figure 100. GPR profile of Column Test 17 (C-17)

Column Test 18 (C-18)

Orientation	130° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 40 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

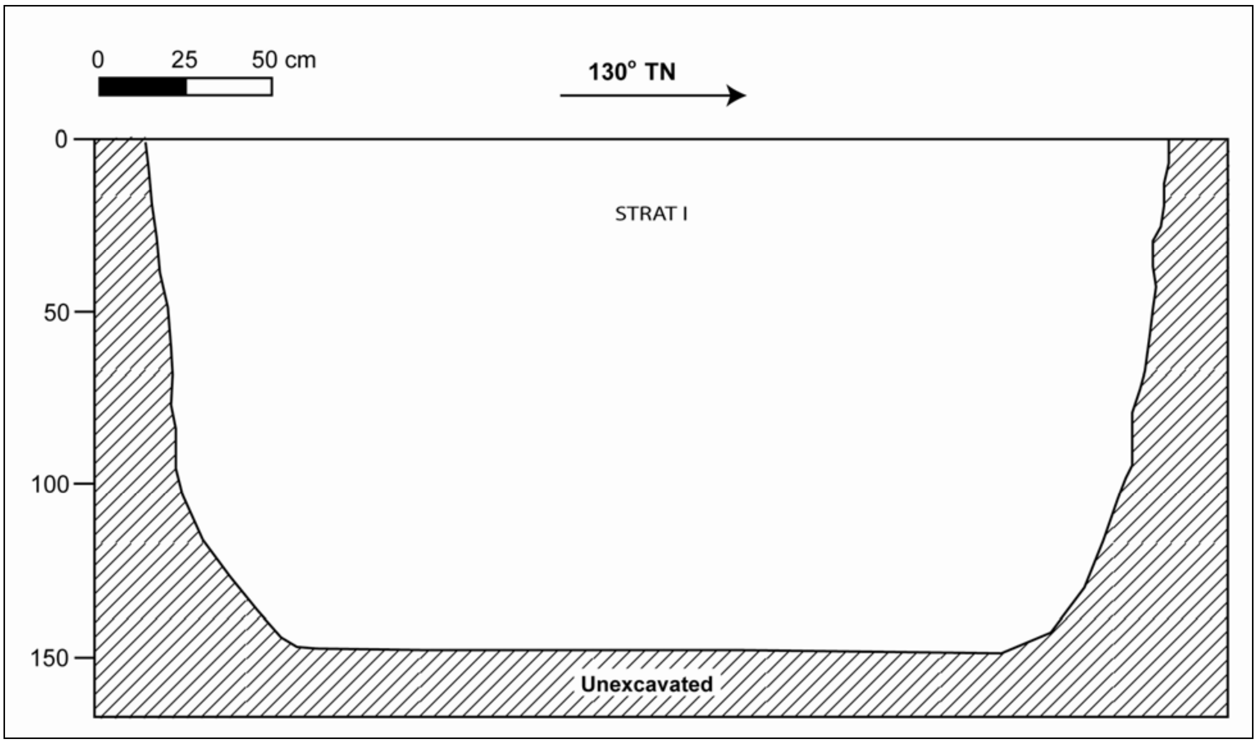

Figure 101. Profile of Column Test 18 (C-18)

Figure 102. Photograph of Column Test 18 (C-18), view to northeast

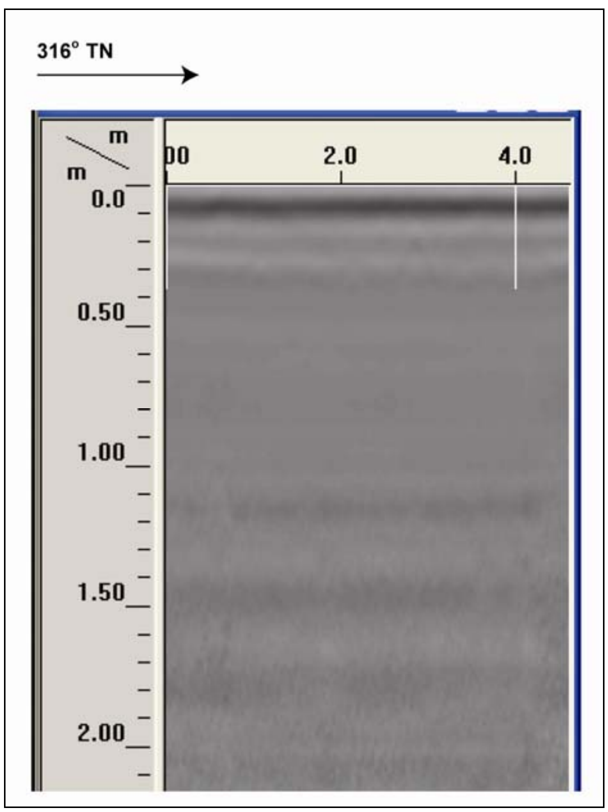

Figure 103. GPR profile of Column Test 18 (C-18)

4.7 Construction Sheet RW007

Construction Sheet RW007 consists of a 2,200 ft (0.7 km) segment of the proposed transit corridor situated within Farrington Highway (Figure 104). Five column test pits (C-5, C-6, C-6 alt, C-7 & C-8) were excavated within Construction Sheet RW007.

4.7.1 Pedestrian Inspection

This segment of the project area is situated entirely within the Farrington Highway Right of Way. The segment is relatively undeveloped with the exception of the Kāhi Mōhala Behavioral Health Center located on the *makai*/south side of the roadway (Figure 105). The proposed route along which the transit is to traverse has been subjected to extensive disturbance in association with road construction. Examination of the grading for Farrington Highway in comparison to the surrounding landscape shows that it is elevated up ~20 feet/6.1 meters from the rest of the surrounding area (Figure 106). This is likely due to the flooding that the area is prone to during heavy rains. No cultural resources were observed during the surface survey of the section of the project area.

4.7.2 GPR Survey

Prior to the excavation of column test pits, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey of column test pits C-5, C-6, and C-6 alt identified numerous subsurface anomalies that likely corresponded to coral and basalt cobbles and boulders that were observed dispersed throughout various stratums during test excavation (Figure 109, Figure 112, & Figure 114).

The GPR survey also identified the stratigraphic interface between the coral and basalt gravel fill layers and the underlying sediments documented in column test pits C-7 and C-8 (Figure 115 & Figure 118). The subtle horizontal banding shown from approximately 0 to 50 cmbs in the GPR profiles seems to correspond to the coral and basalt gravel fill layers observed during excavation (Figure 117 & Figure 120). It is believed that the variance in consistency and compaction between the coral and basalt gravel fill layers and the underlying sediments allowed the GPR to delineate the stratigraphic interface between them.

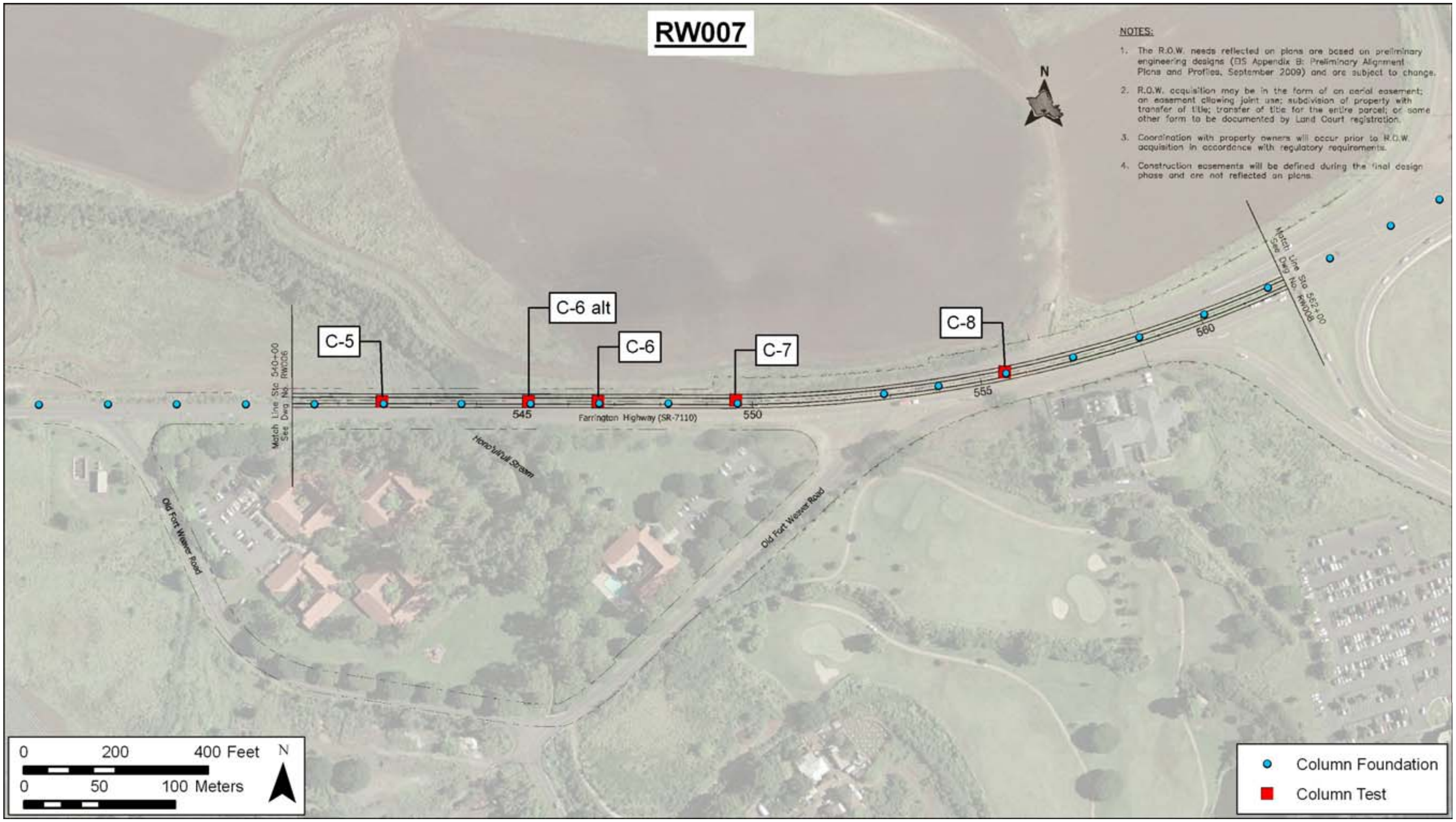

Figure 104. Construction Sheet RW007 showing the location of test excavations

Figure 105. Photo of transit route along Farrington Highway as it heads eastward towards Waipahu

Figure 106.Photograph of Farrington Highway prior to entering Waipahu area along the proposed route for the transit; note the difference in elevation of the road versus the areas along side it

4.7.3 Subsurface Testing

4.7.3.1 Stratigraphic Summary

Five (5) test excavations were placed within the area delineated by Construction Sheet RW007 (see Figure 104). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 39 to Figure 53).

In general the observed and documented stratigraphy consisted of a varying layers of fill associated with the construction of Farrington Highway and the installation of subsurface utilities. Fill layers consisted of basalt gravel, crushed coral, and previously disturbed alluvial sediments originating from the area. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.7.3.2 Excavation Documentation

Column Test 5 (C-5)

Orientation	3° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.26 m

Stratum	Depth (cmbs)	Description
Ia	0-61	Fill Horizon; 10 YR 6/3, pale brown; silt; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; wind-blown and construction deposits along side of road
Ib	58-124	Fill Horizon; 10 YR 4/3, brown; silty clay loam; moderate, fine, crumb, blocky structure; hard dry consistency; no cementation; Natural sediment used to create berm for roadway; contains cobbles, boulders
Ic	100-106	Basalt gravel fill for existing 36" water main
II	123-126	Basalt bedrock

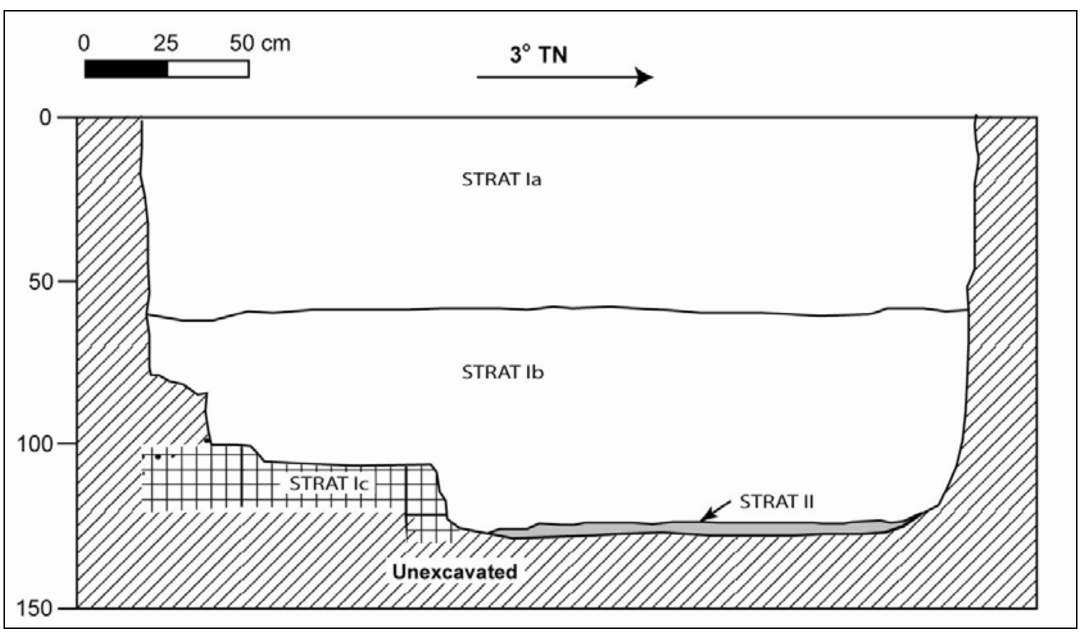

Figure 107. Profile of Column Test 5 (C-5)

Figure 108. Photograph of Column Test 5 (C-5), view to west

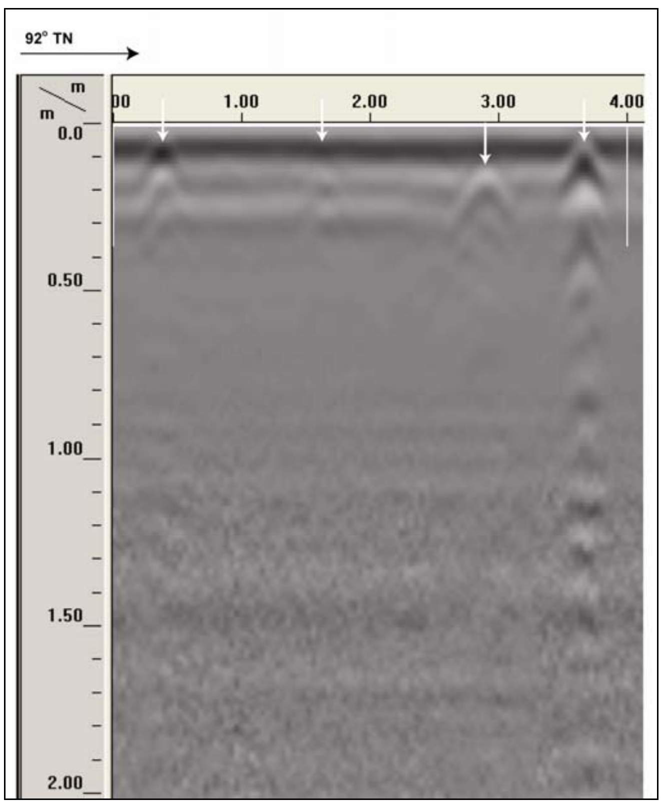

Figure 109. GPR profile of Column Test 5 (C-5)

Column Test 6 (C-6)

Orientation	356° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.18 m

Stratum	Depth (cmbs)	Description
Ia	0-118	Fill; 7.5 YR 4/2, brown; silty clay loam; weak, fine, crumb structure; dry loose consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Previously disturbed, naturally deposited sediment.
Ib	95-118	Basalt gravel fill for existing 36" water main

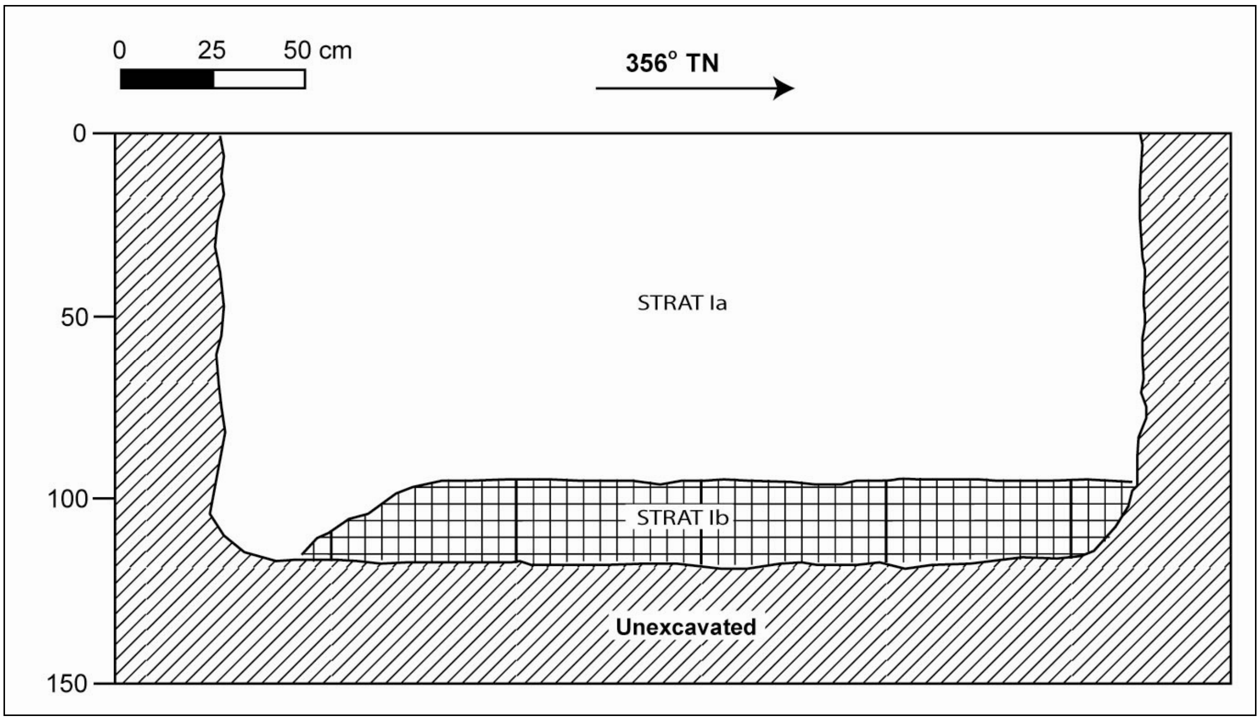

Figure 110. Profile of Column Test 6 (C-6)

Figure 111. Photograph of Column Test 6 (C-6), view to west

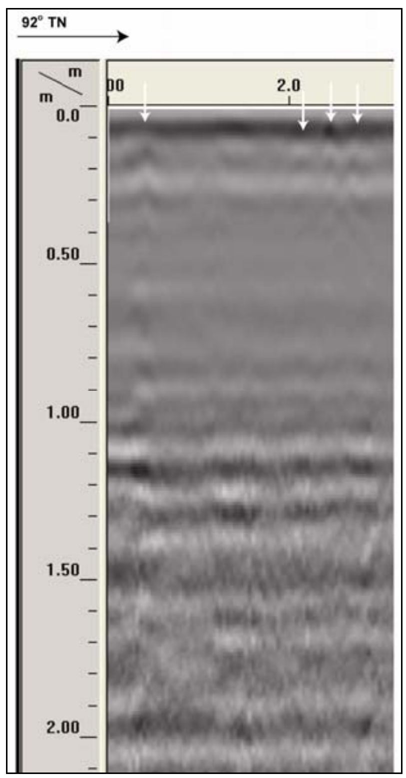

Figure 112. GPR profile of Column Test 6 (C-6)

Column Test 6 alternate (C-6 alt)

Orientation	92° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
Ia	0-118	Fill; 7.5 YR 4/2, brown; silty clay loam; weak, fine, crumb structure; dry loose consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Previously disturbed, naturally deposited sediment.
Ib	95-118	Basalt gravel fill for existing 36" water main

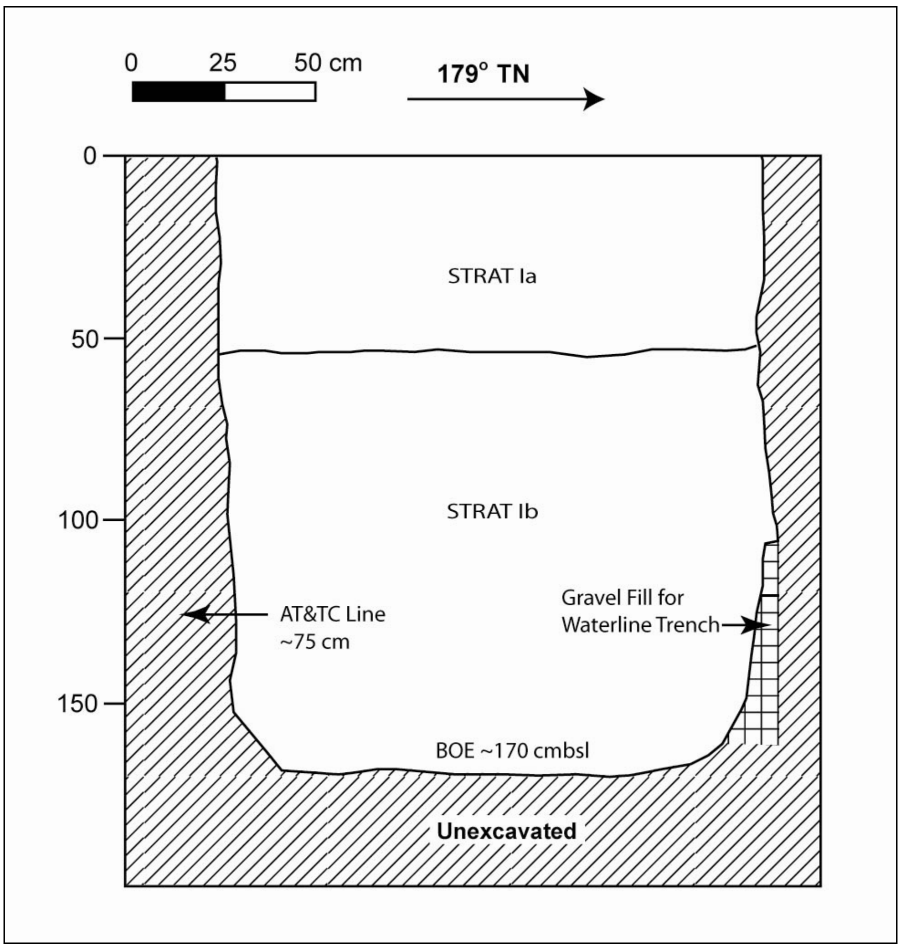

Figure 113. Profile of Column Test 6 alternate (C-6 alt)

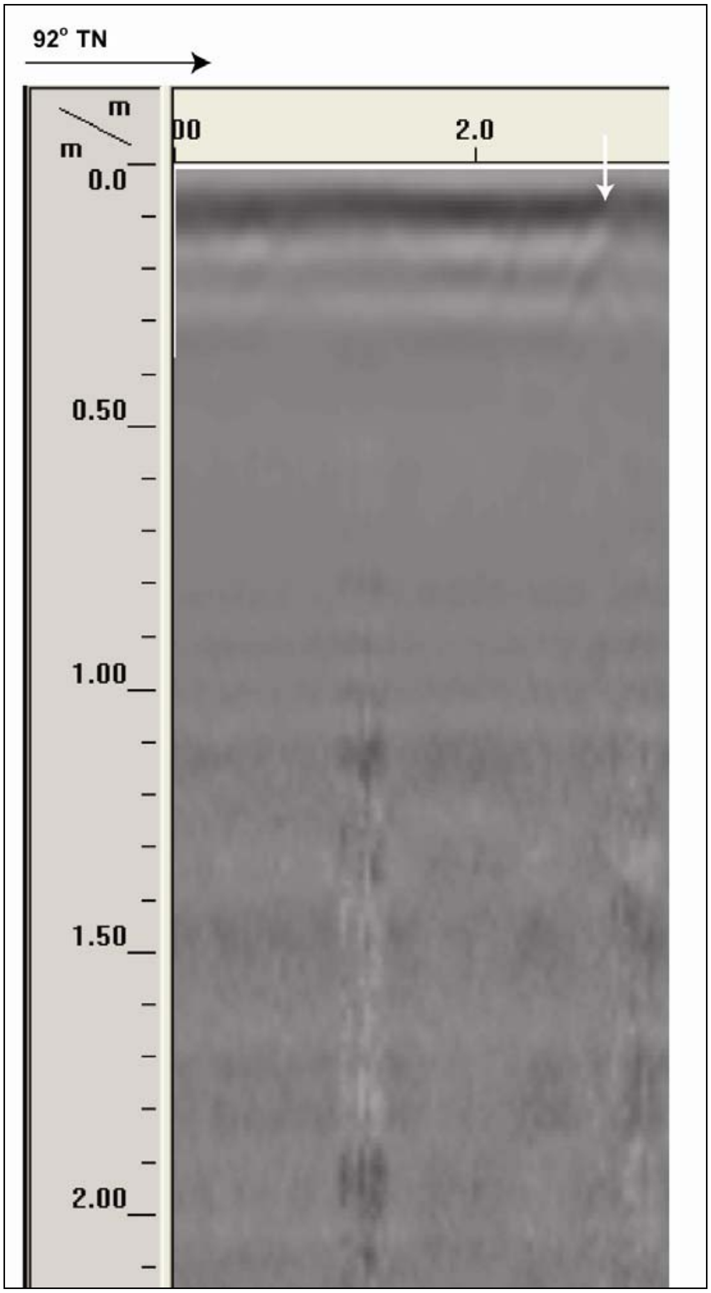

Figure 114. GPR profile of Column Test 6 alternate (C-6 alt)

Column Test 7 (C-7)

Orientation	359° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.2 m

Stratum	Depth (cmbs)	Description
Ia	40-120	Fill; 7.5 YR 4/2, brown; silty clay; weak, fine, crumb structure; loose dry consistency; loose moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; terrigenous fill material containing small cobbles, coral, pebbles
Ib	116-120	Basalt gravel fill for existing 36" water main

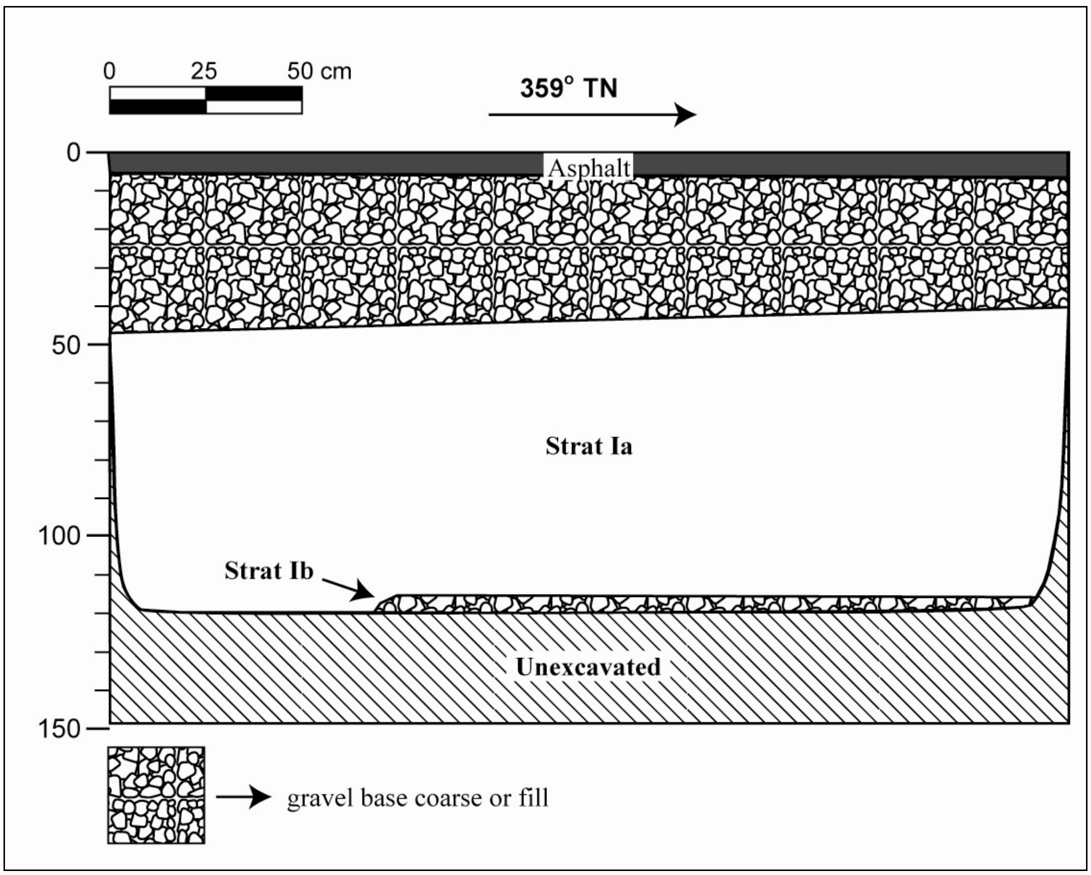

Figure 115. Profile of Column Test 7 (C-7)

Figure 116. Photograph of Column Test 7 (C-7), view to west

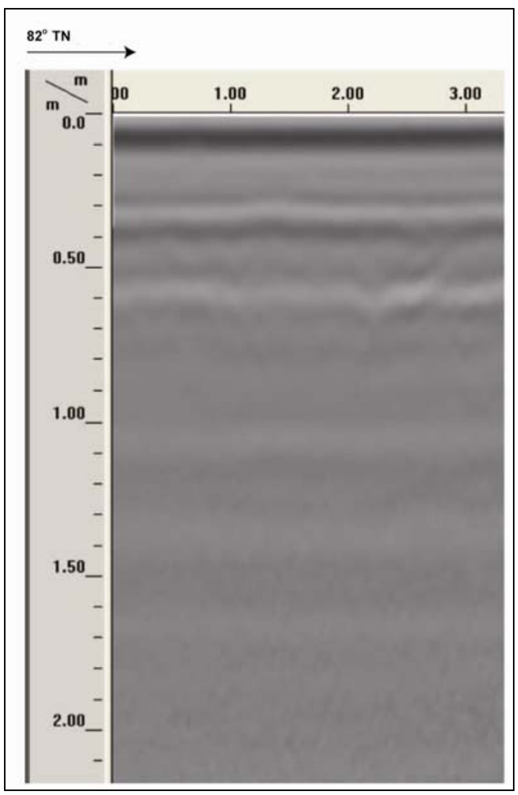

Figure 117. GPR profile of Column Test 7 (C-7)

Column Test 8 (C-8)

Orientation	259° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt road surface
Ib	10-20	Fill Horizon; 5 YR 5/3, reddish brown; silty clay; moderate, fine, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; abrupt smooth lower boundary;
Ic	20-40	Crushed coral fill
II	40-150	5 YR 4/4, reddish brown; garvelly, clay loam; moderate, fine, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; terrestrial origin.

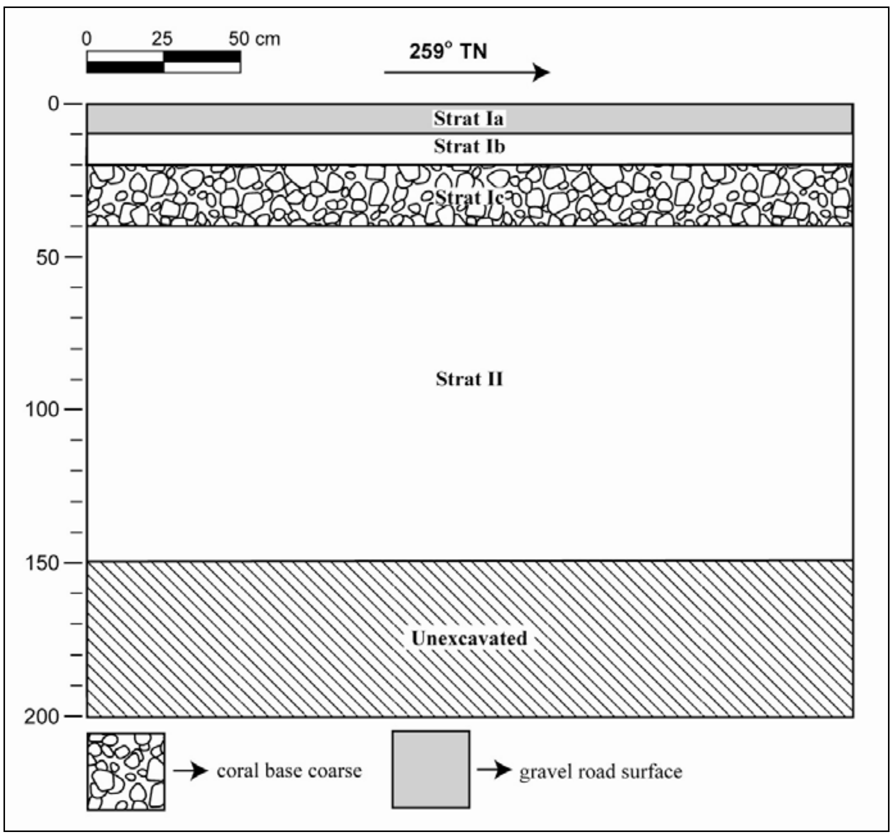

Figure 118. Profile of Column Test 8 (C-8)

Figure 119. Photograph of Column Test 8 (C-8), view to south

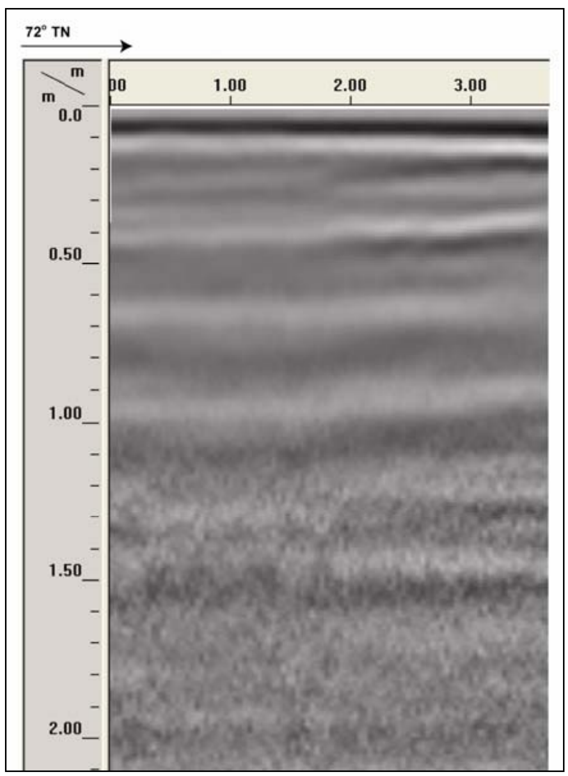

Figure 120. GPR profile of Column Test 8 (C-8)

4.8 Construction Sheet RW008

Construction Sheet RW008 consists of a 2,700 ft (0.8 km) segment of the proposed transit corridor and includes the proposed West Loch Station (Figure 121 & Figure 122). Twelve test trenches were excavated at the station, as well as two column test pits (C-9 and C-10) located to the northwest, totaling 14 test excavations within Construction Sheet RW008.

4.8.1 Pedestrian Inspection

Along this section of the project area the proposed transit route follows Farrington Highway into the highly urbanized town of Waipahu. The formerly single lane highway expands to a multi-lane (four) highway as it enters the town of Waipahu (Figure 123). Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.8.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey was able to define the stratigraphic interfaces within the top 25 to 50 cm of all test areas. The subtle horizontal banding shown from approximately 0 to 50 cmbs in the GPR profiles seems to correspond to asphalt or concrete surfaces and their underlying gravel cushions (see Figure 124 thru Figure 165). It is believed that the variance in consistency and compaction between the asphalt, concrete, and basalt gravel fill layers and the underlying sediments allowed the GPR to delineate the stratigraphic interface between them.

Of particular interest was the GPRs inability to locate subsurface utilities that were observed during test excavation at column test 9 (C-9). Numerous metal and PVC pipes were observed during excavation, but no indication of them was present during the GPR survey (Figure 161 & Figure 162). It is believed that soil chemistry is the primary factor to this discrepancy. Column test 9 (C-9) is in the vicinity of agricultural fields that are likely fertilized with potassium and/or nitrogen, which would increase the conductivity of the soils causing limited depth “visibility” and accuracy of the GPR. Also the red color of the soils in this area is likely a sign of high iron content, which would further increase the conductivity of the soil.

In general, the results of the GPR survey were inconclusive. While the GPR was able to delineate stratigraphic interfaces within the top 25 to 50 cm of all test areas, subsurface utilities and other subsurface objects (i.e. buried stream bed deposits, gravel layers, etc.) observed during test excavation were not located. Additionally, the maximum “visibility” within the study area ranged from 75 to 100 cm below the surface. It is believed that the environmental conditions (i.e. soil chemistry) present within Construction Sheet RW008 caused the sediments to be too conductive causing the radar waves to disperse, resulting in limited depth “visibility” and inaccurate data output. Thus it appears that the area defined by Construction Sheet RW008 is not

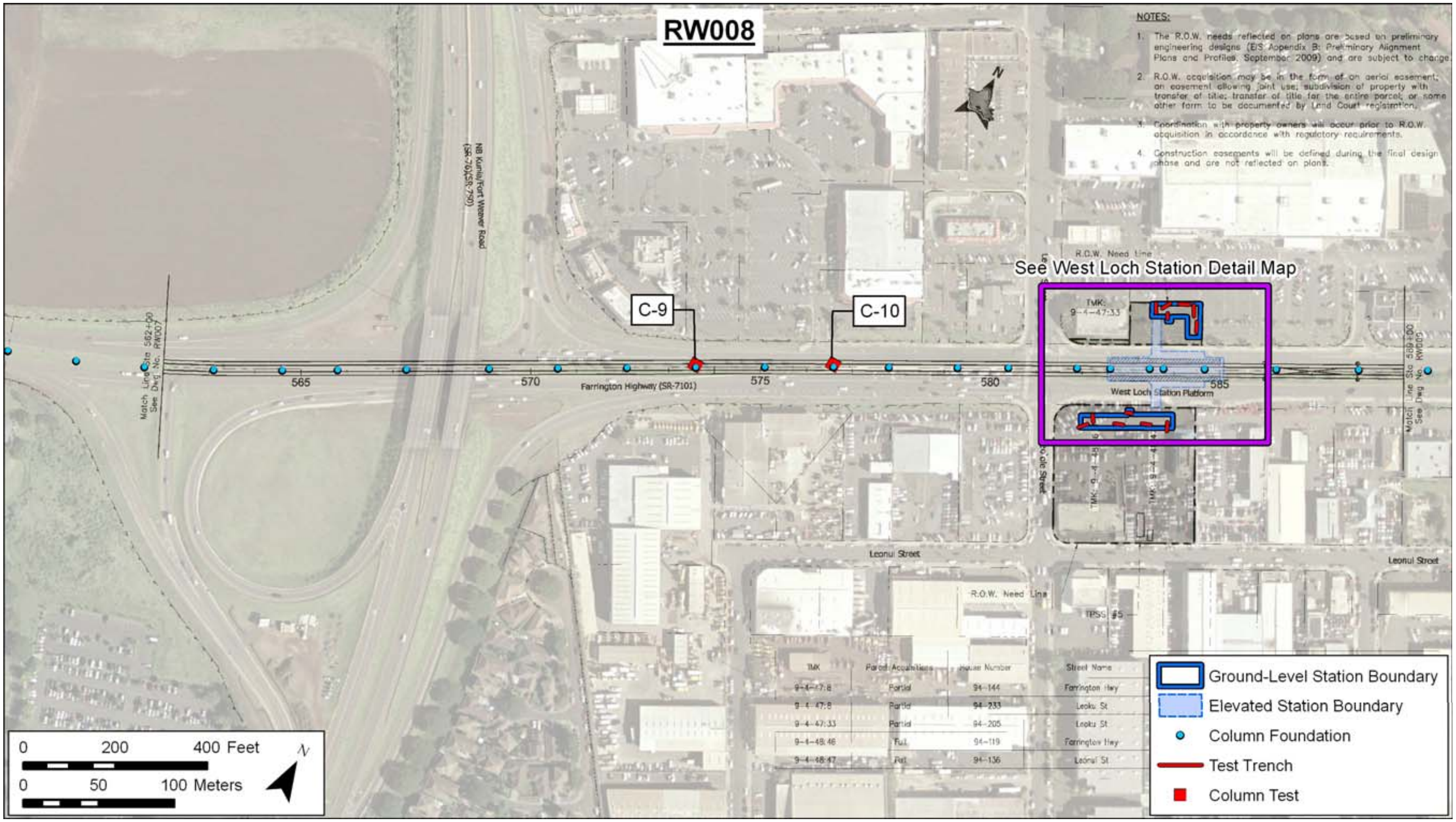

Figure 121. Construction Sheet RW008 showing the location of test excavations

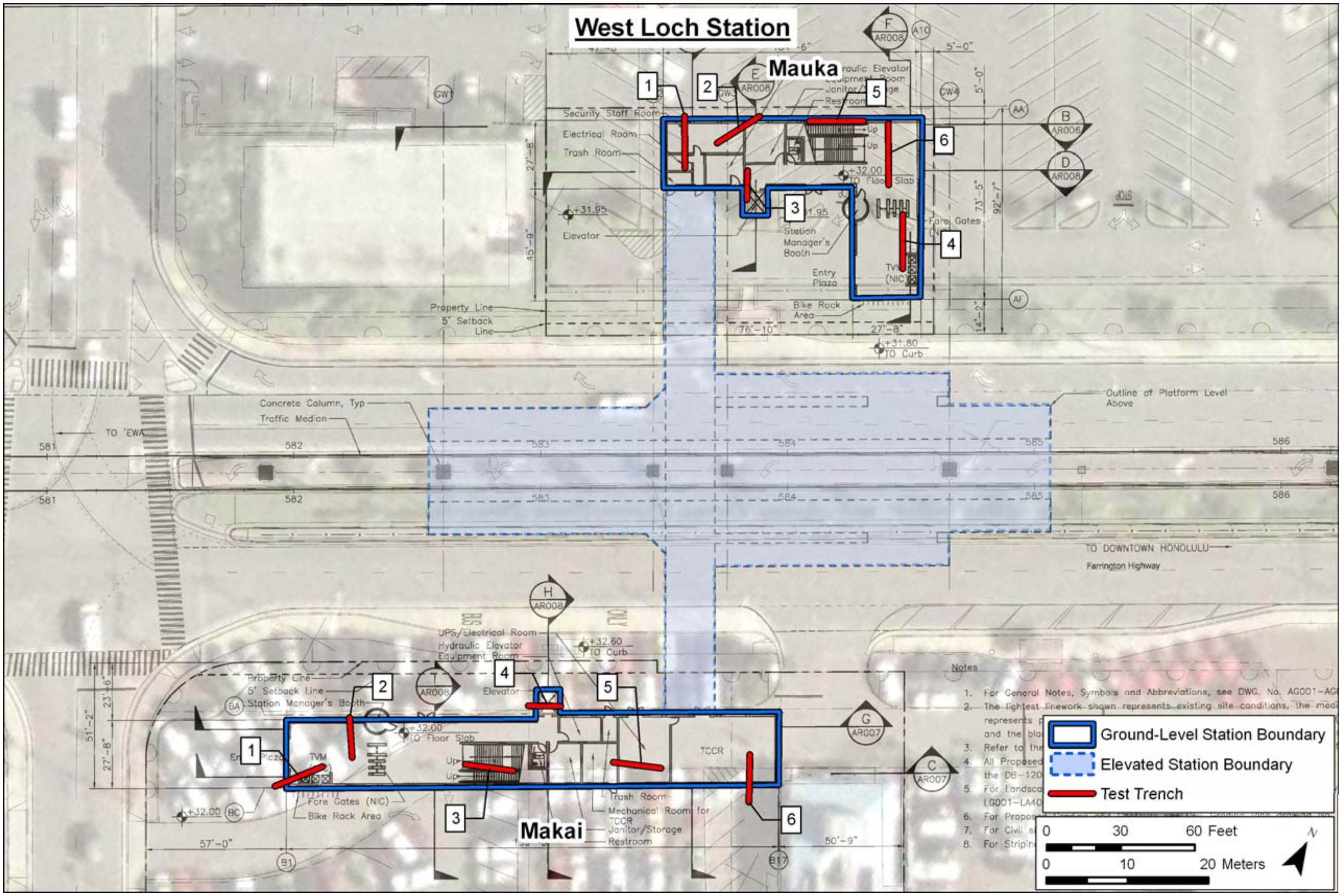

Figure 122. West Loch Station floor plan showing the location of test trenches

Figure 123. Photo of project route along Farrington Highway as it extends into Waipahu

viable for an accurate GPR survey. This conclusion is consistent the NRCS, which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

4.8.3 Subsurface Testing

4.8.3.1 Stratigraphic Summary

Fourteen (14) test excavations were placed within the area delineated by Construction Sheet RW008 (see Figure 121 & Figure 122). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavations, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 124 to Figure 164).

In general the observed and documented stratigraphy consisted of an asphalt paved surface with an associated gravel base course, a thin layer of imported silt loam, followed by varying layers of naturally deposited alluvial silt. Of note were the presence of layers and pockets of water rounded basalt cobbles within some of the test trenches (see West Loch Station Mauka Test Trench 4 and West Loch Station Makai Test Trench 1, 2, 4-6). This suggests that the immediate area once had running water prior to urban development. Based on the results of test excavations it is believed that prior to urban and historic development this area consisted of at least one meandering or braided stream course.

These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.8.3.2 Excavation Documentation

West Loch Station Mauka Test Trench 1

Orientation	150° TN
Length	7m
Width	0.7m
Maximum Depth	2.1m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	30-65	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt smooth lower boundary; natural sediments
III	65-105	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt smooth lower boundary; natural sediments
IV	105-210	7.5 YR 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

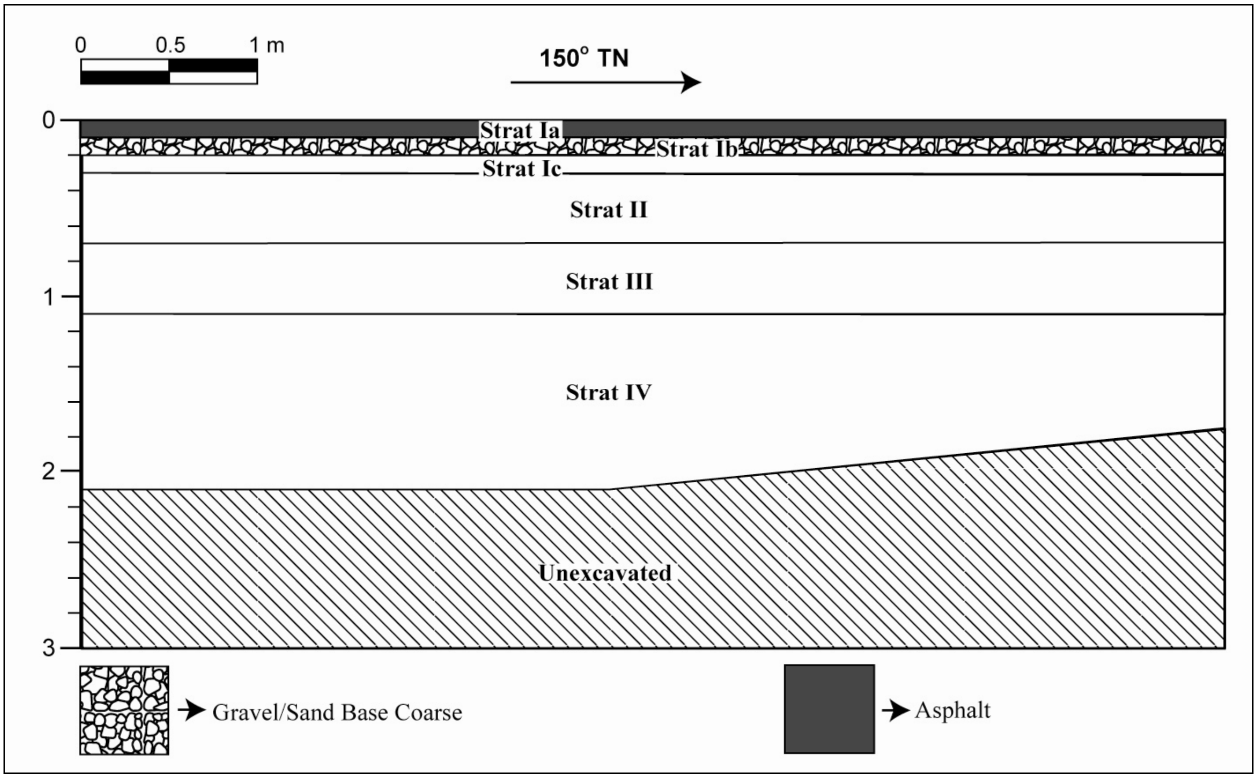

Figure 124. Profile of West Loch Station Mauka Test Trench 1

Figure 125. Photograph of West Loch Station Mauka Test Trench 1, view to north

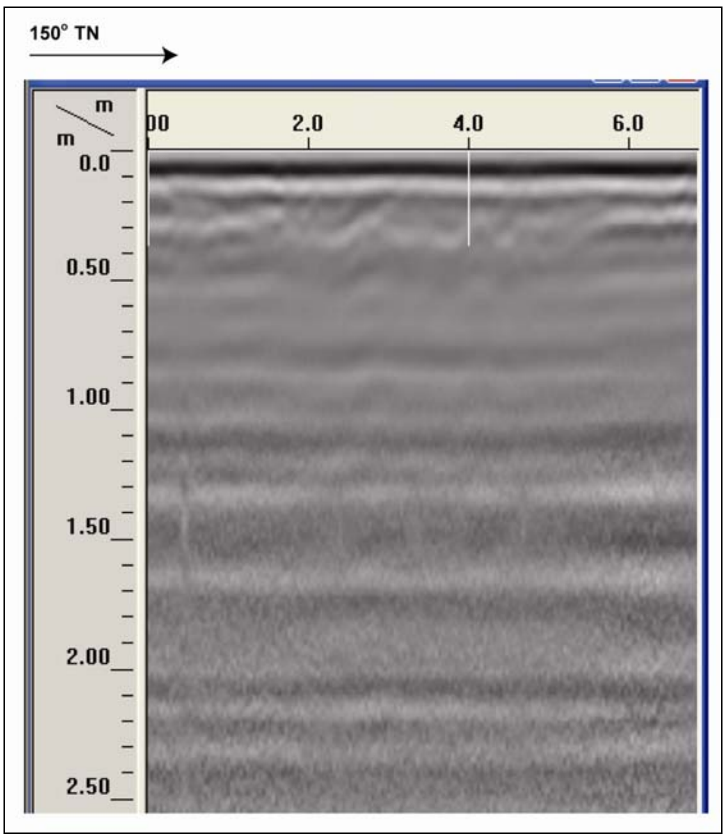

Figure 126. GPR profile of West Loch Station Mauka Test Trench 1

West Loch Station Mauka Test Trench 2

Orientation	338° TN
Length	4 m
Width	0.7 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	25-50	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt irregular lower boundary; natural sediments
III	50-70	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt wavy lower boundary; natural sediment
IV	70-200	7.5 YR 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

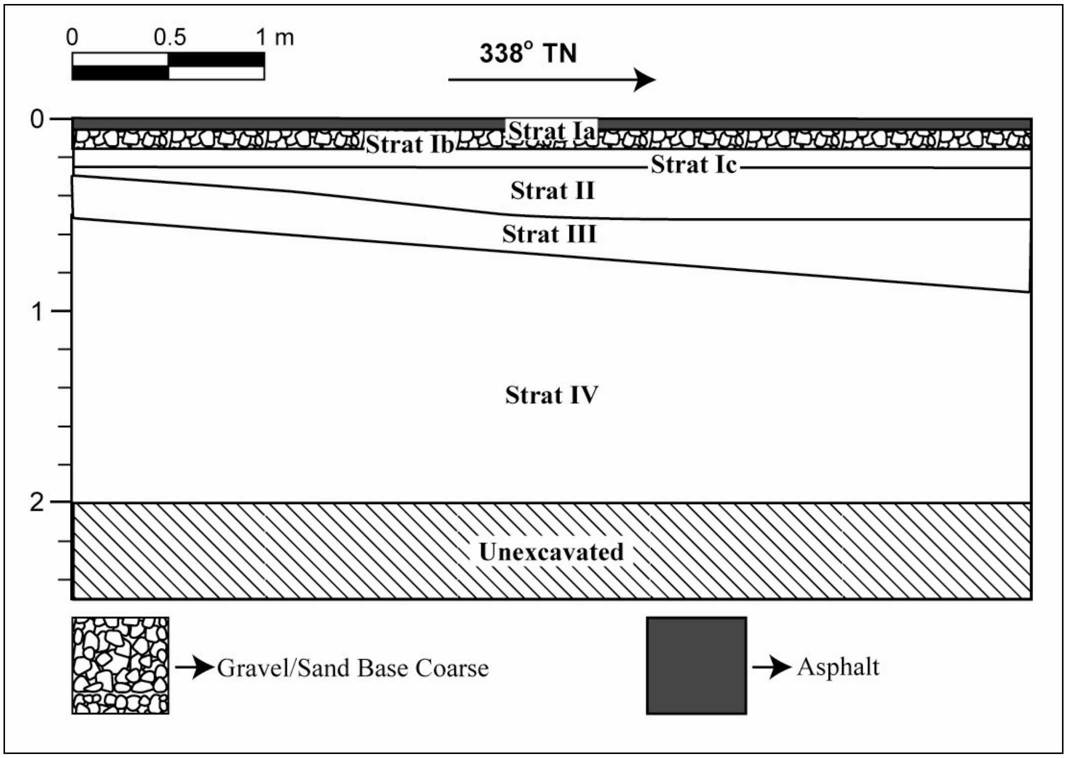

Figure 127. Profile of West Loch Station Mauka Test Trench 2

Figure 128. Photograph of West Loch Station Mauka Test Trench 2, view to south

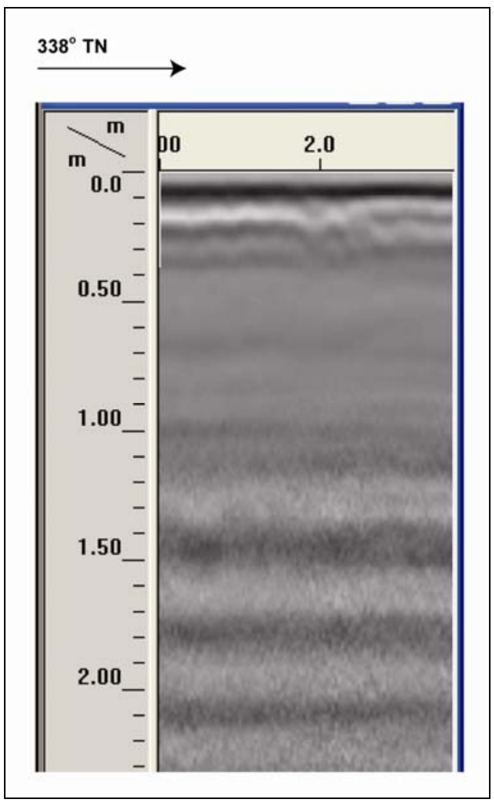

Figure 129. GPR profile of West Loch Station Mauka Test Trench 2

West Loch Station Mauka Test Trench 3

Orientation	26° TN
Length	6.5 m
Width	0.7 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	40-140	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
III	140-190	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
IV	190-210	7.5 Yr 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

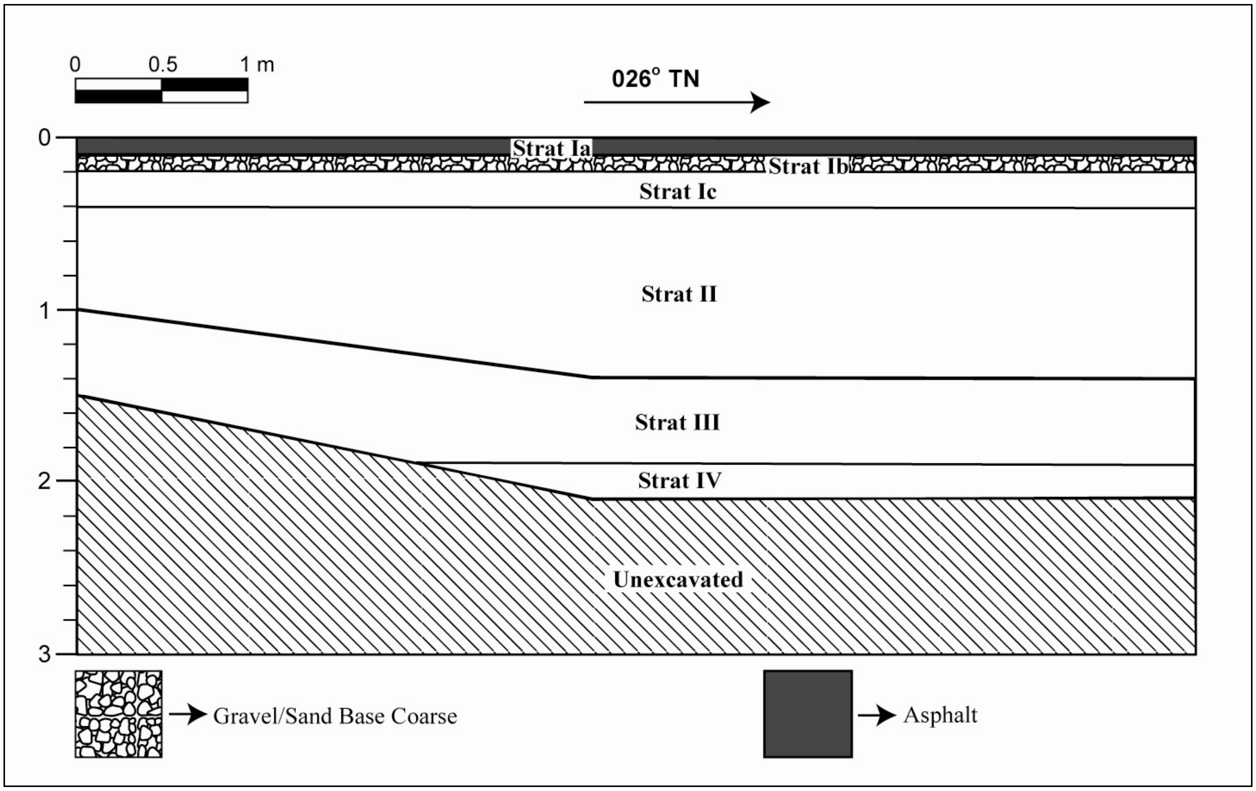

Figure 130. Profile of West Loch Station Mauka Test Trench 3

Figure 131. Photograph of West Loch Station Mauka Test Trench 3, view to southwest

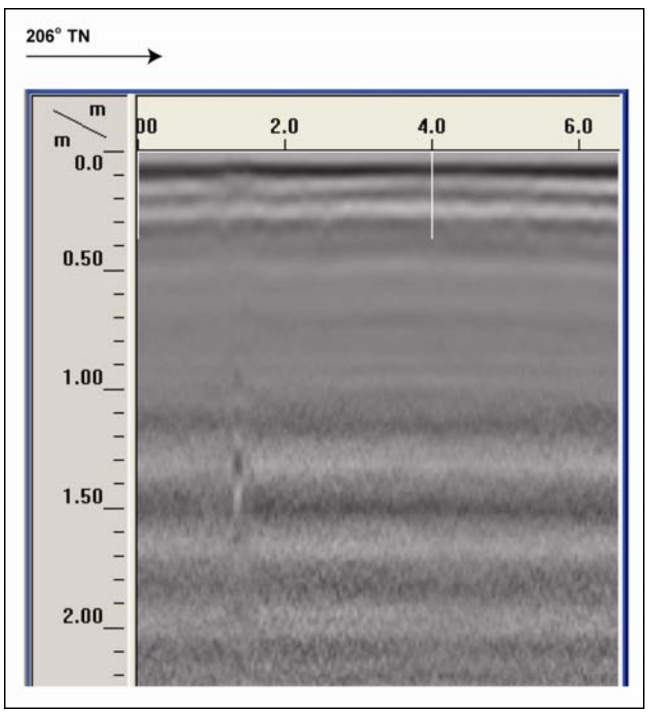

Figure 132.GPR profile of West Loch Station Mauka Test Trench 3

West Loch Station Mauka Test Trench 4

Orientation	150° TN
Length	7 m
Width	0.7 m
Maximum Depth	2.2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
Id	30-70	10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; graded natural sediments
II	70-80	water worn basalt layer; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt wavy lower boundary; natural sediments, stream bed or flooding episode
III	80-115	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
IV	115-125	5 Yr 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
V	125-220	7.5 YR 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

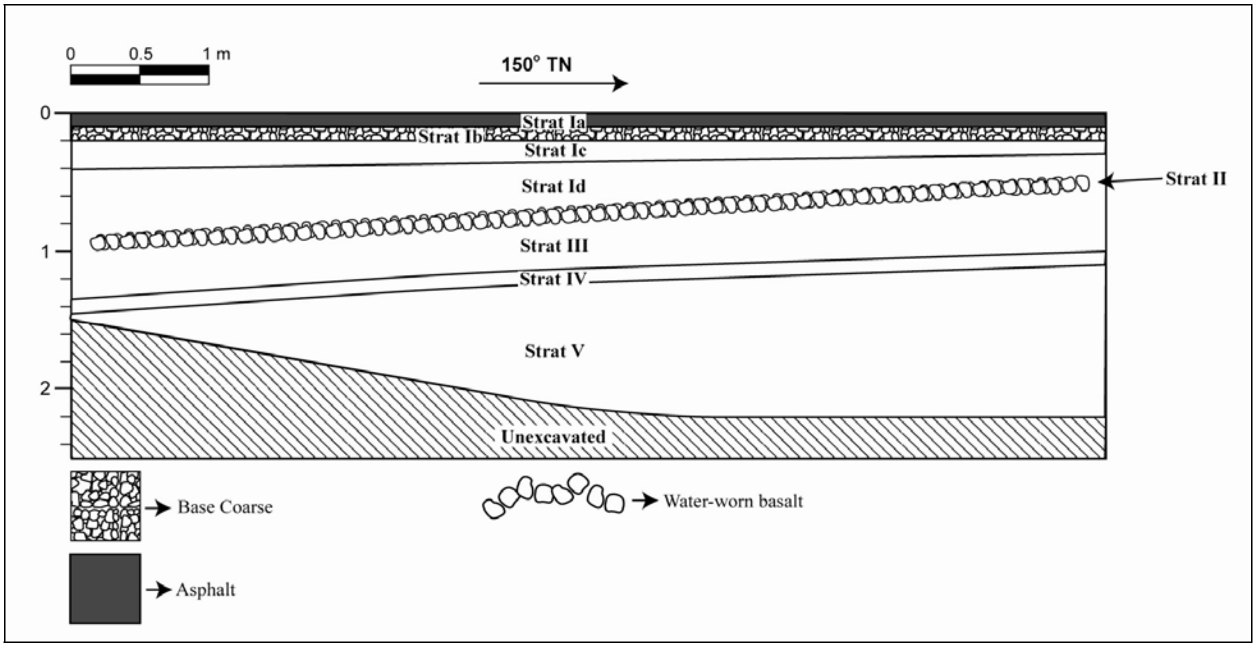

Figure 133. Profile of West Loch Station Mauka Test Trench 4

Figure 134. Photograph of West Loch Station Mauka Test Trench 4, view to east

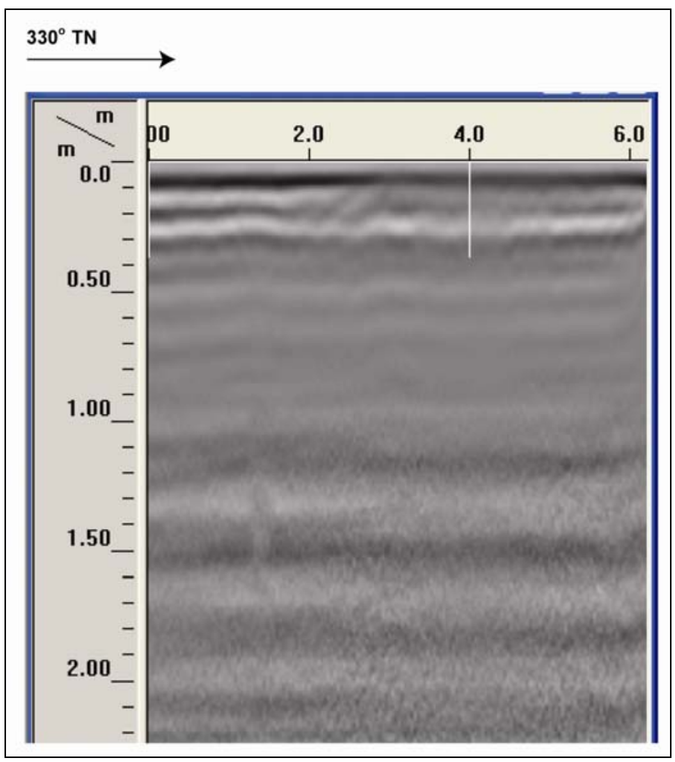

Figure 135. GPR profile of West Loch Station Mauka Test Trench 4

West Loch Station Mauka Test Trench 5

Orientation	065° TN
Length	6 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	20-75	5 YR 4/6, yellowish red; silt loam; moderate, medium, granular structure; very hard dry consistency; non-plastic; strong cementation; abrupt smooth lower boundary; natural sediment
III	39-68	10 YR 3/3, dark brown; silt; strong, granular structure; extremely hard dry consistency; non-plastic; indurated; abrupt smooth lower boundary; natural sediment
IV	68-200	5 YR 3/4, dark reddish brown; silt; moderate, medium, granular structure; extremely hard dry consistency; non-plastic; indurated; natural sediment

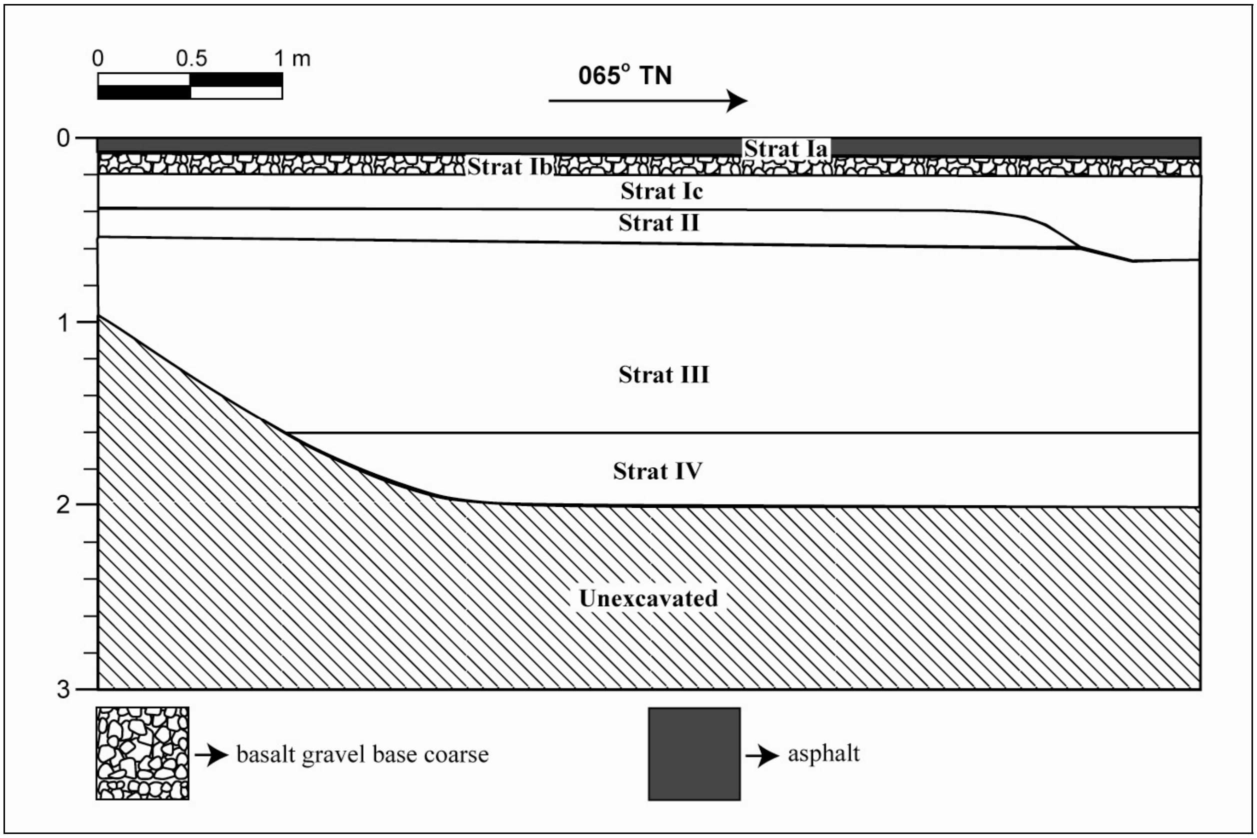

Figure 136. Profile of West Loch Station Mauka Test Trench 5

Figure 137. Photograph of West Loch Station Mauka Test Trench 5, view to northwest

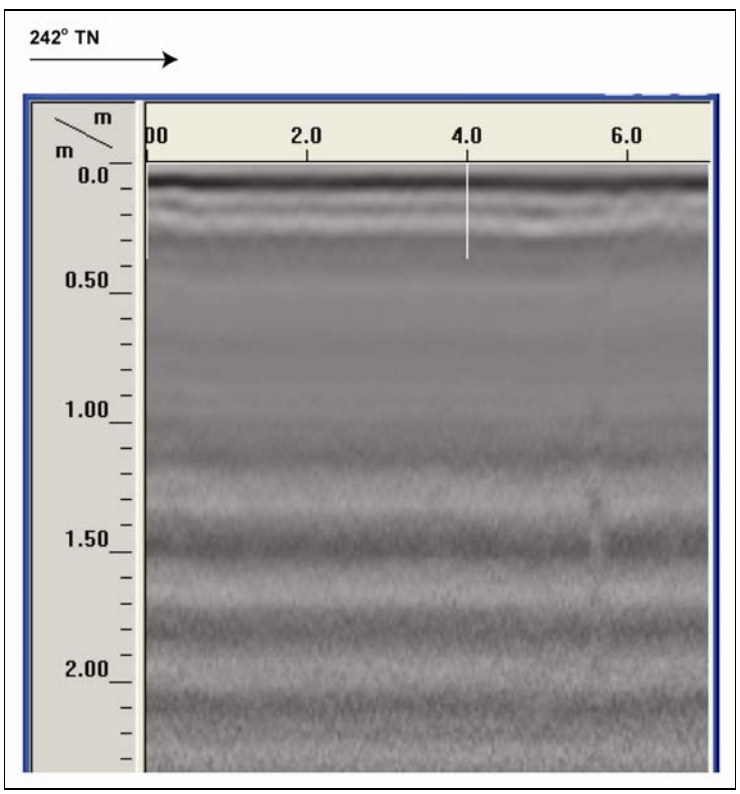

Figure 138. GPR profile of West Loch Station Mauka Test Trench 5

West Loch Station Mauka Test Trench 6

Orientation	150° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	60-160	10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
III	160-220	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; natural sediments

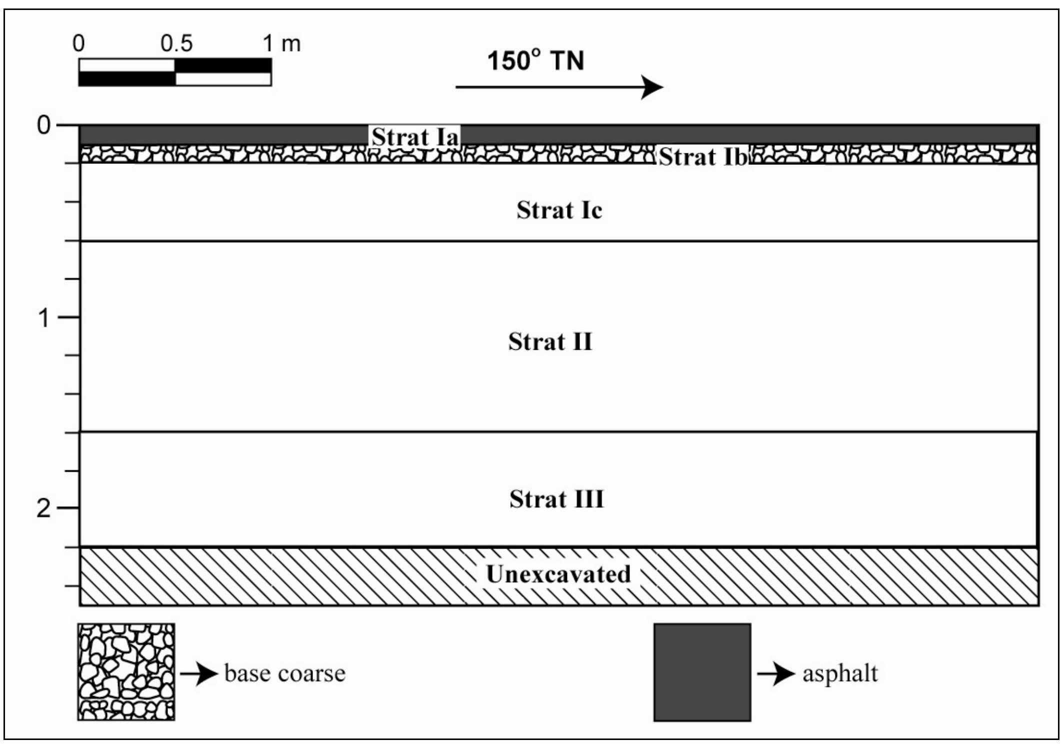

Figure 139. Profile of West Loch Station Mauka Test Trench 6

Figure 140. Photograph of West Loch Station Mauka Test Trench 6, view to north

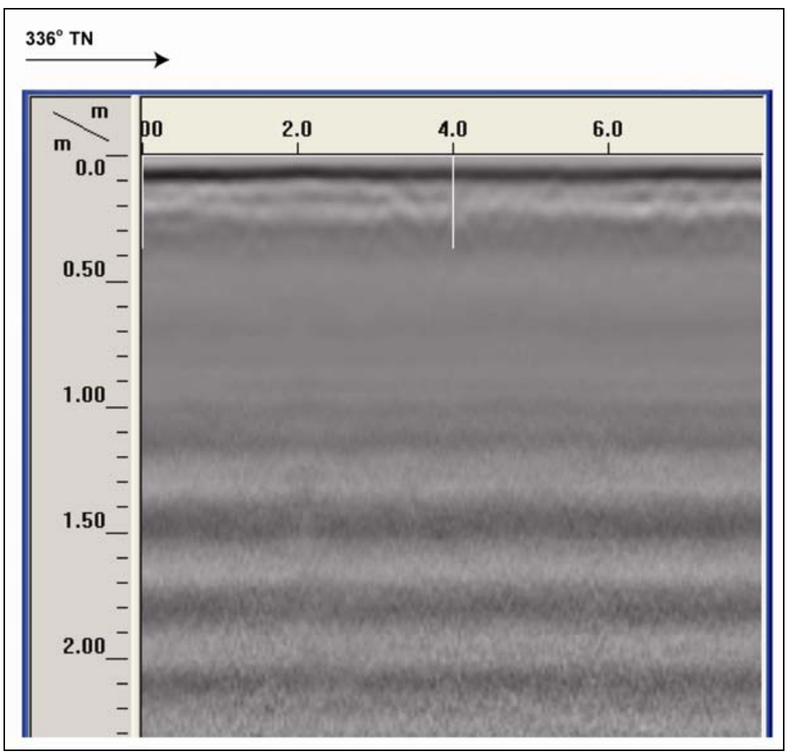

Figure 141. GPR profile of West Loch Station Mauka Test Trench 6

West Loch Station Makai Test Trench 1

Orientation	030° TN
Length	5.5 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-82	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	82-213	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin. Near base of excavation medium to large water-worn basalt cobbles were observed, suggestive of the presance of a stream bed.

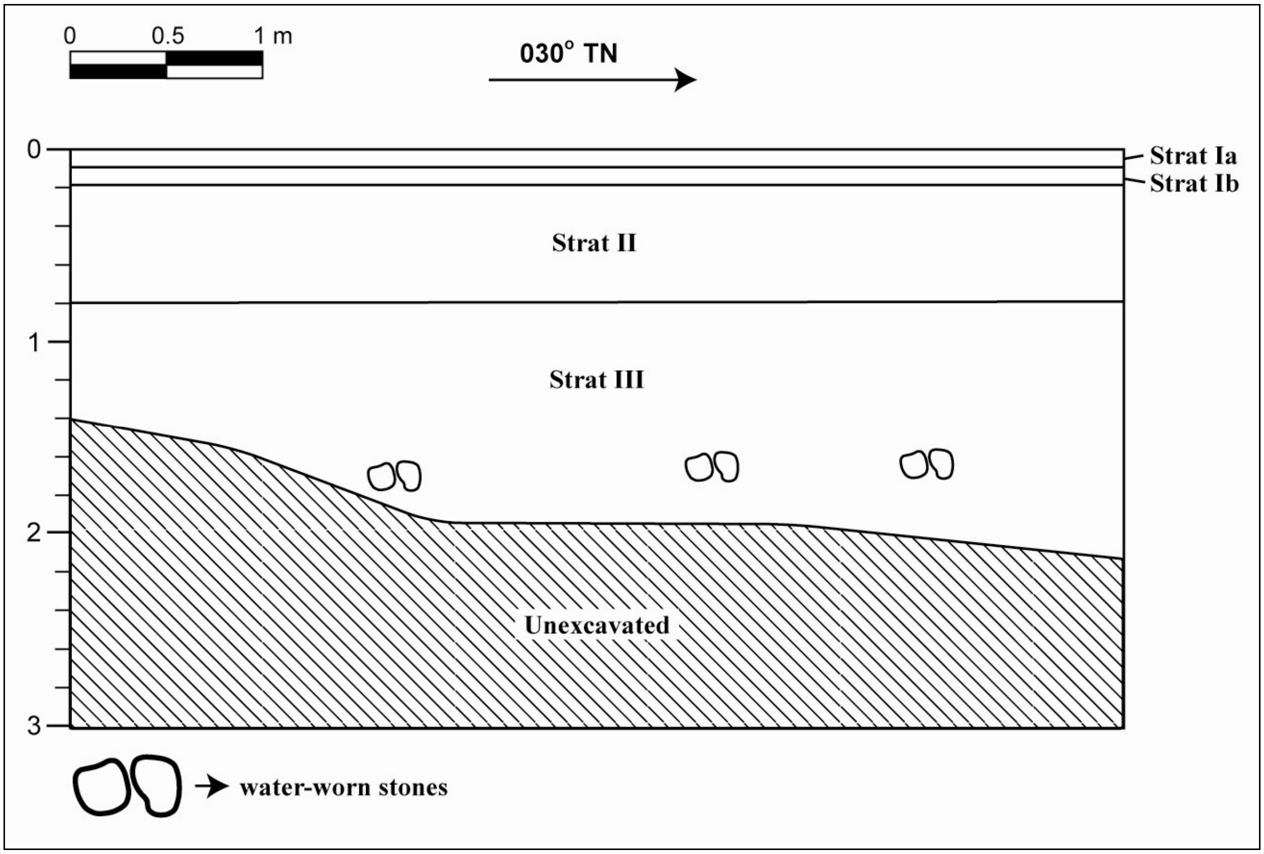

Figure 142. Profile of West Loch Station Makai Test Trench 1

Figure 143. Photograph of West Loch Station Makai Test Trench 1, view to west

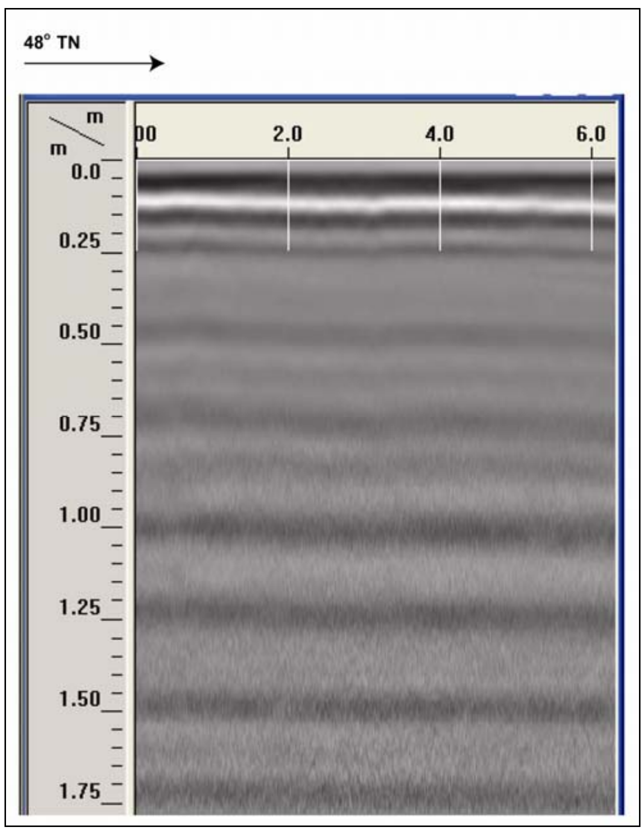

Figure 144. GPR profile of West Loch Station Makai Test Trench 1

West Loch Station Makai Test Trench 2

Orientation	330° TN
Length	4 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-96	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	96-200	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin. Water rounded cobbles observed at base of excavation, likely the remnant of a stream.

Figure 145. Profile of West Loch Station Makai Test Trench 2

Figure 146. Photograph of West Loch Station Makai Test Trench 2, view to west

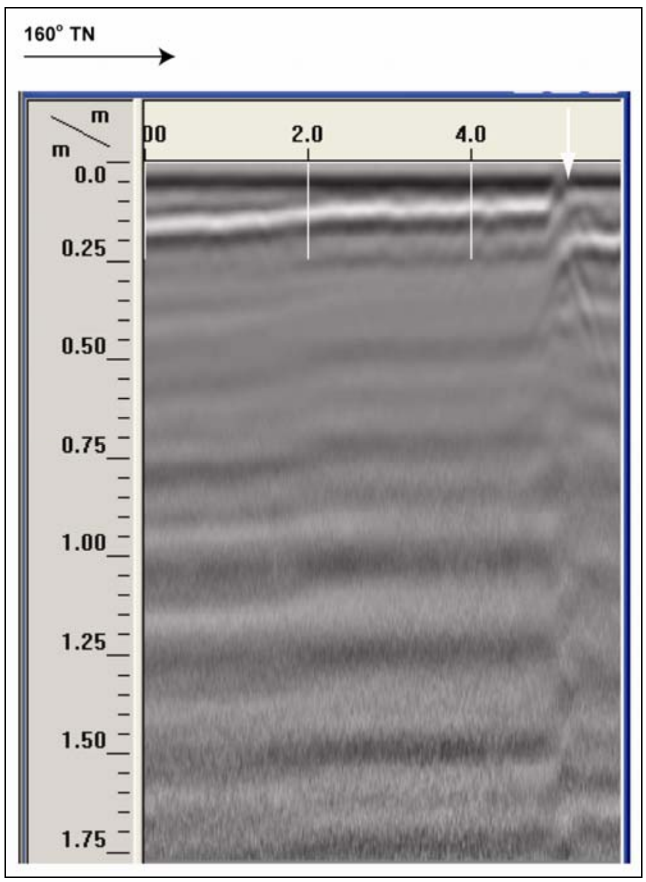

Figure 147. GPR profile of West Loch Station Makai Test Trench 2

West Loch Station Makai Test Trench 3

Orientation	070° TN
Length	6 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Crushed coral fill
II	20-75	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	75-210	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin.
IV	75-210	10 YR 3/3 dark brown; clay; strong fine crumb structure; dry very hard consistency; non plastic; no cementation; terrestrial origin.

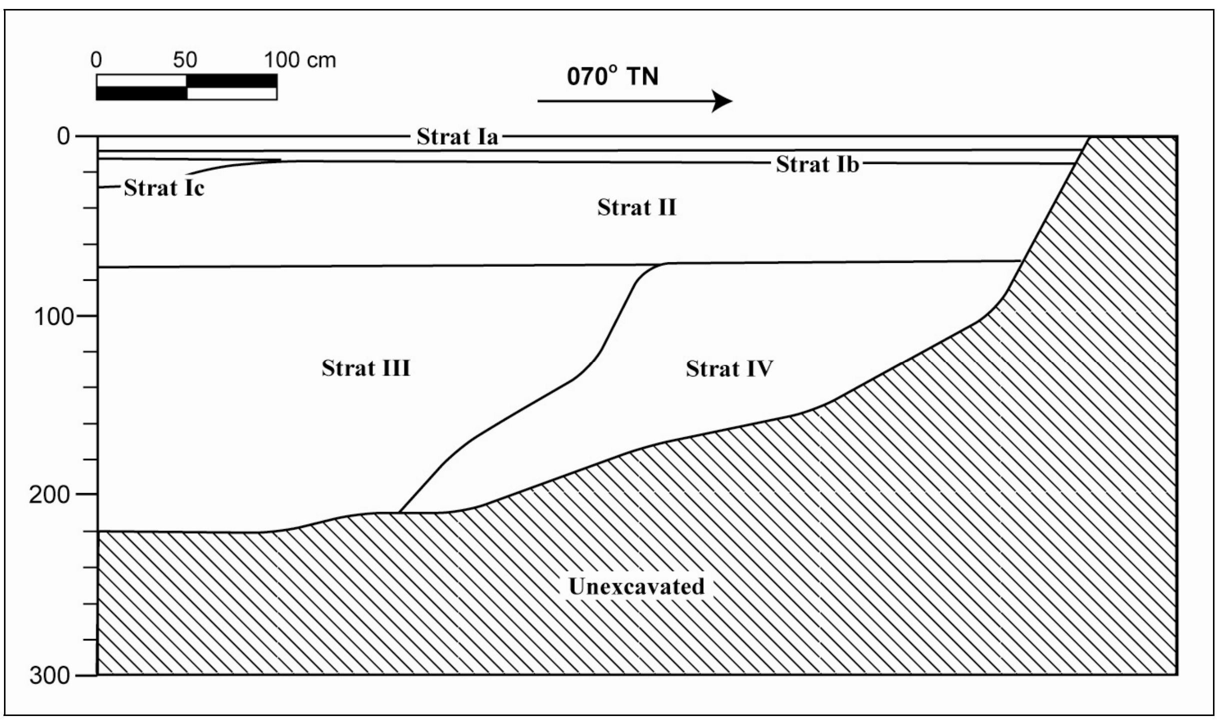

Figure 148. Profile of West Loch Station Makai Test Trench 3

Figure 149. Photograph of West Loch Station Makai Test Trench 3, view to north

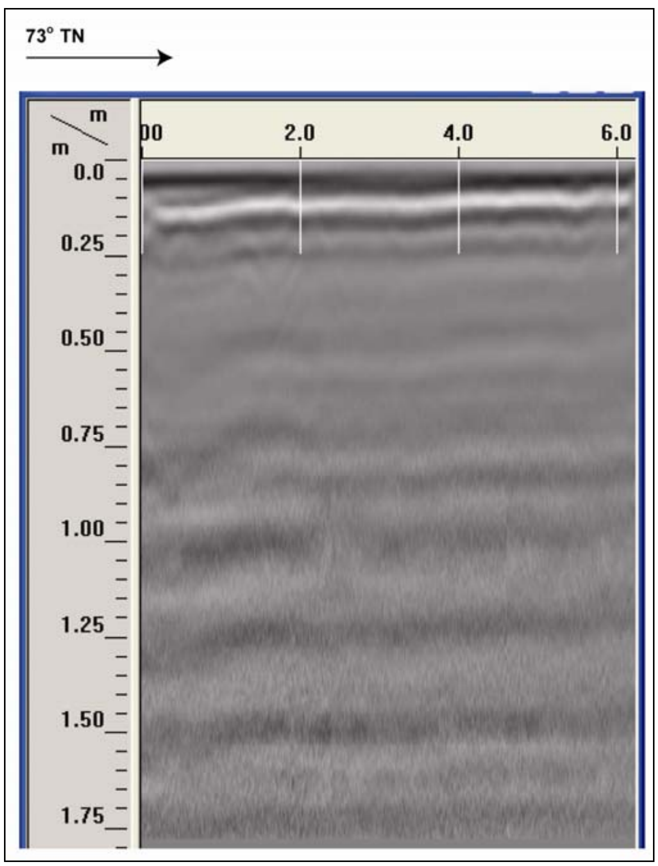

Figure 150. GPR profile of West Loch Station Makai Test Trench 3

West Loch Station Makai Test Trench 4

Orientation	240° TN
Length	4.2 m
Width	0.8 m
Maximum Depth	1.9 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	27-80	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	80-190	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin. Water rounded cobbles observed at base of excavation, likely the remnant of a stream.

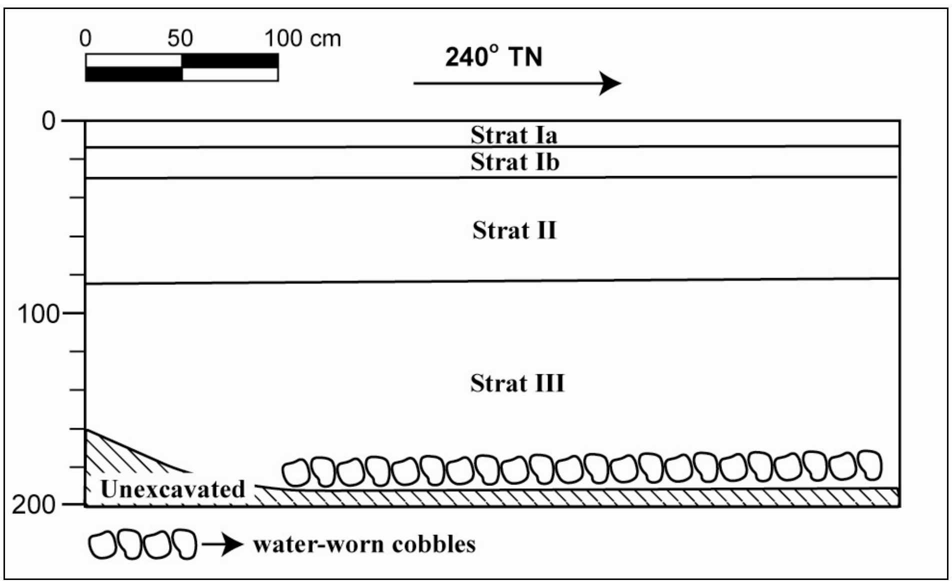

Figure 151. Profile of West Loch Station Makai Test Trench 4

Figure 152. Photograph of West Loch Station Makai Test Trench 4, view to east

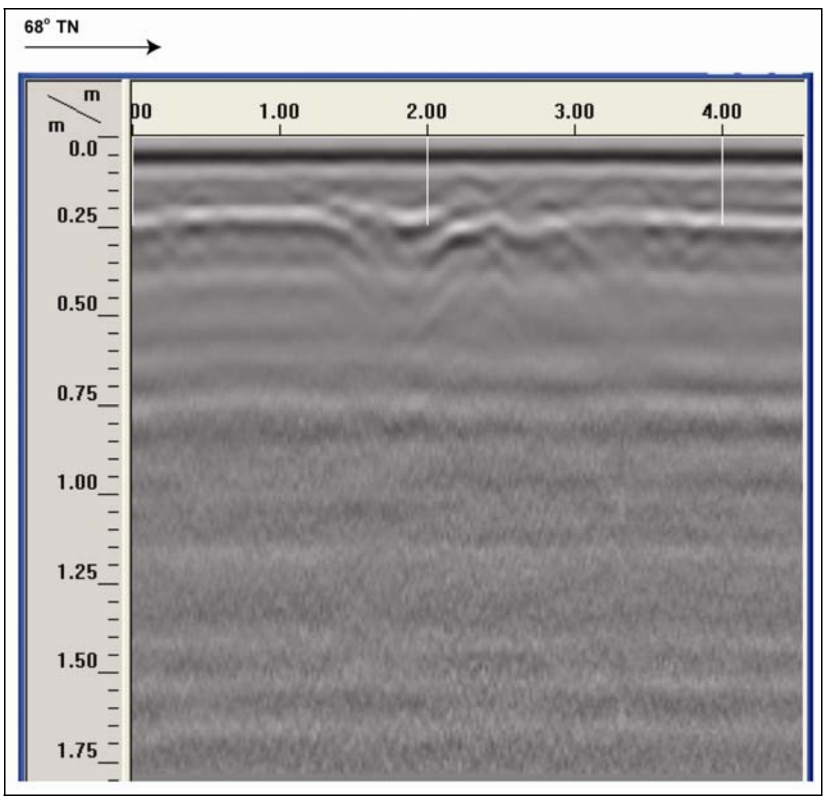

Figure 153. GPR profile of West Loch Station Makai Test Trench 4

West Loch Station Makai Test Trench 5

Orientation	245° TN
Length	6 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-57	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	55-89	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin.
IV	89-200	10 YR 3/3 dark brown; clay; strong fine crumb structure; dry very hard consistency; non plastic; no cementation; terrestrial origin. Water rounded cobbles observed at base of excavation, likely the remnant of a stream.

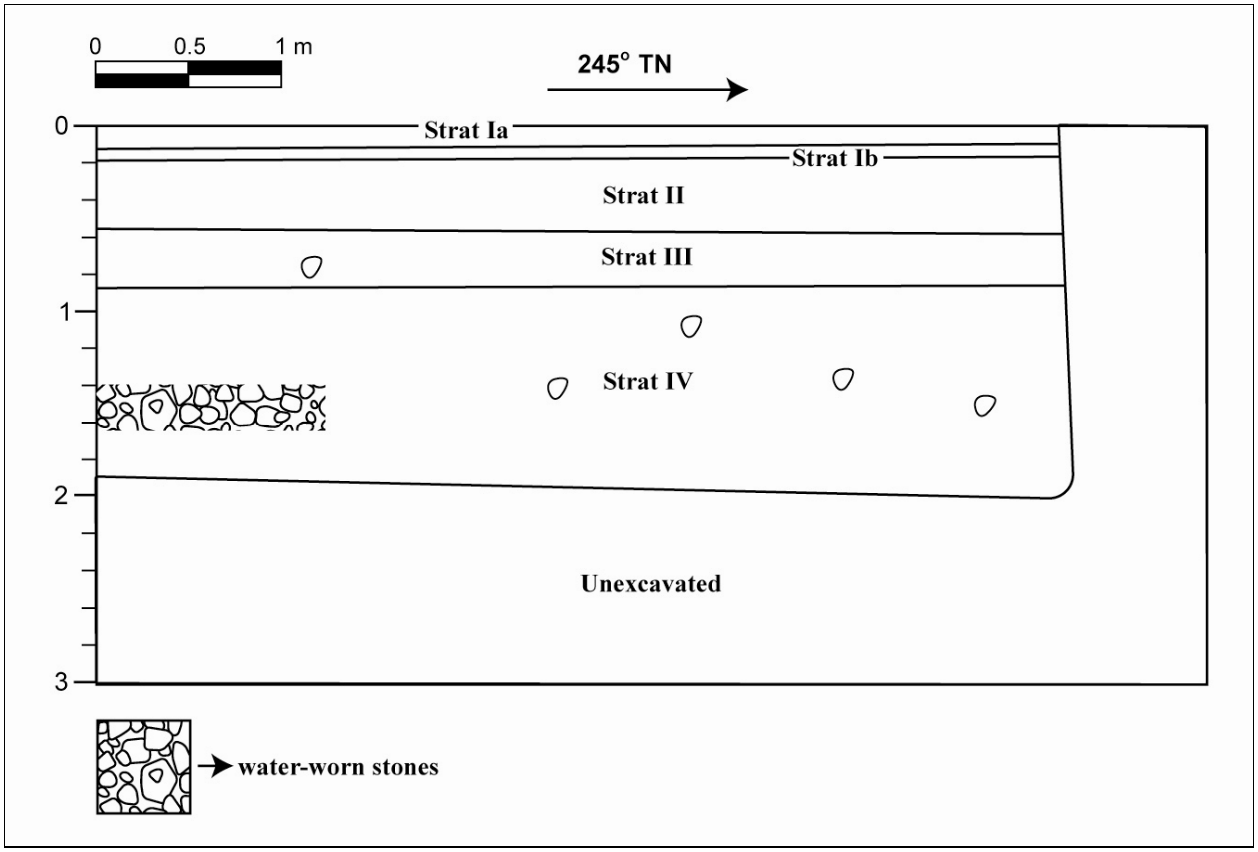

Figure 154. Profile of West Loch Station Makai Test Trench 5

Figure 155. Photograph of West Loch Station Makai Test Trench 5, view to northwest

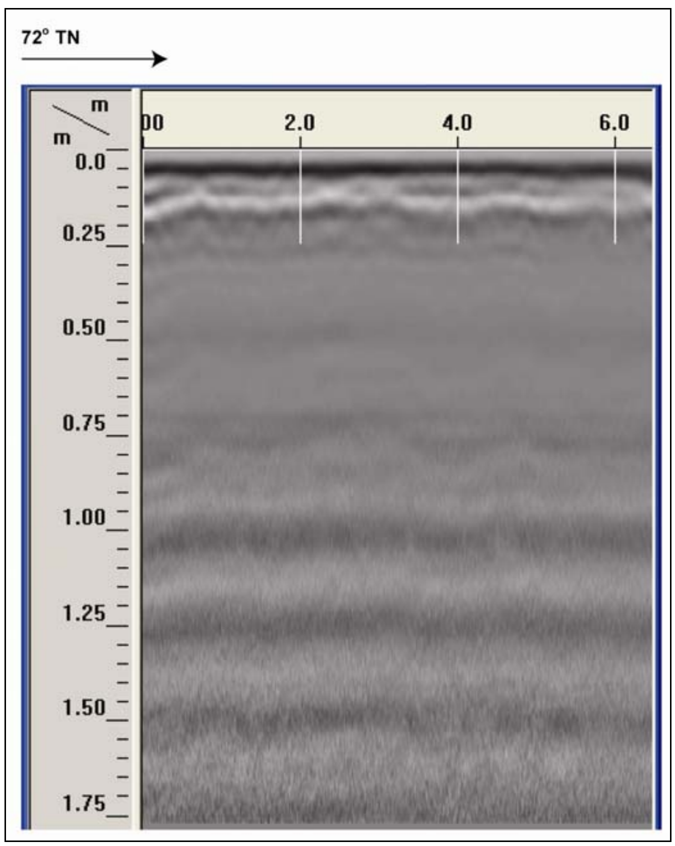

Figure 156. GPR profile of West Loch Station Makai Test Trench 5

West Loch Station Makai Test Trench 6

Orientation	151° TN
Length	6 m
Width	0.8 m
Maximum Depth	1.8 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	25-80	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	80-150	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin.
IV	150-180	10 YR 2/2 dark brown; silty sand; structureless; dry loose consistency; non plastic; no cementation; mixed origin. Contains water-rounded cobbles, likely assocated within a former stream.

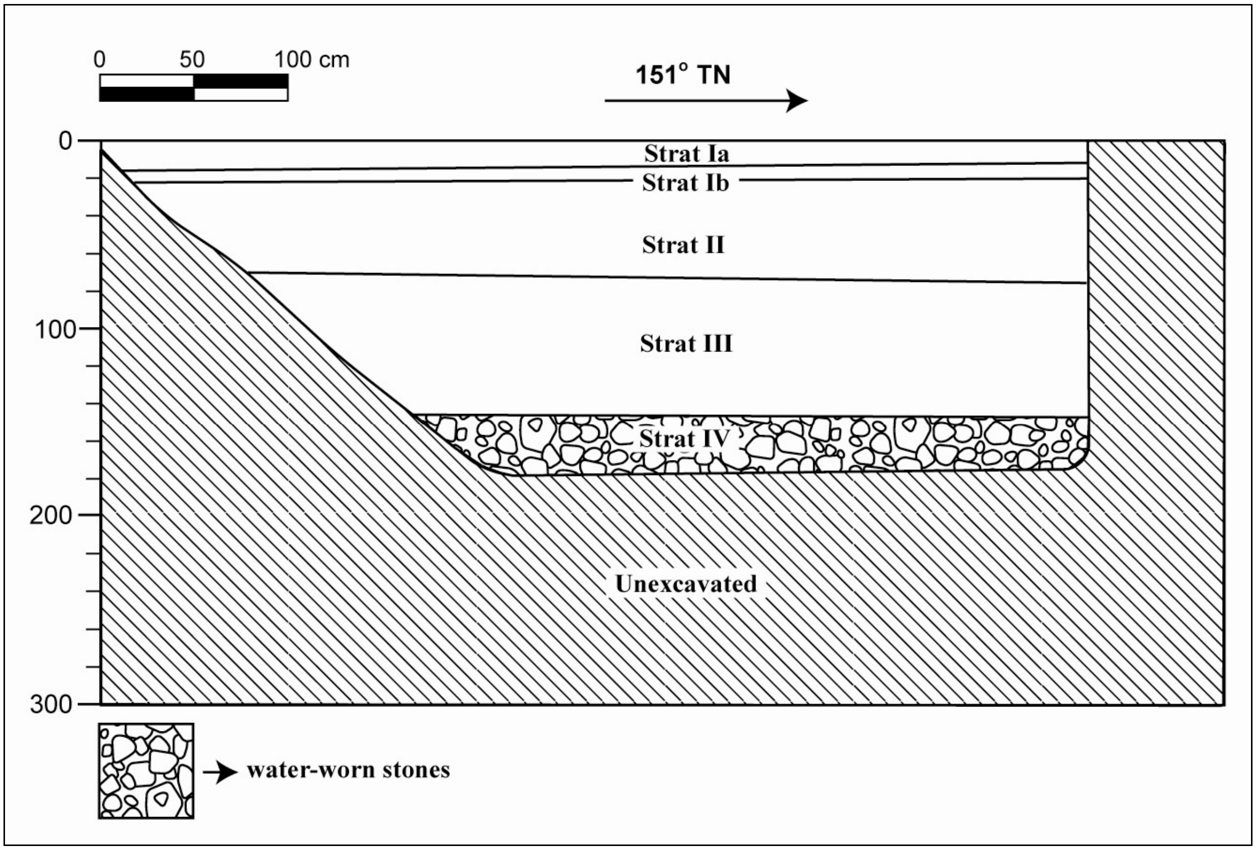

Figure 157. Profile of West Loch Station Makai Test Trench 6

Figure 158. Photograph of West Loch Station Makai Test Trench 6, view to north east

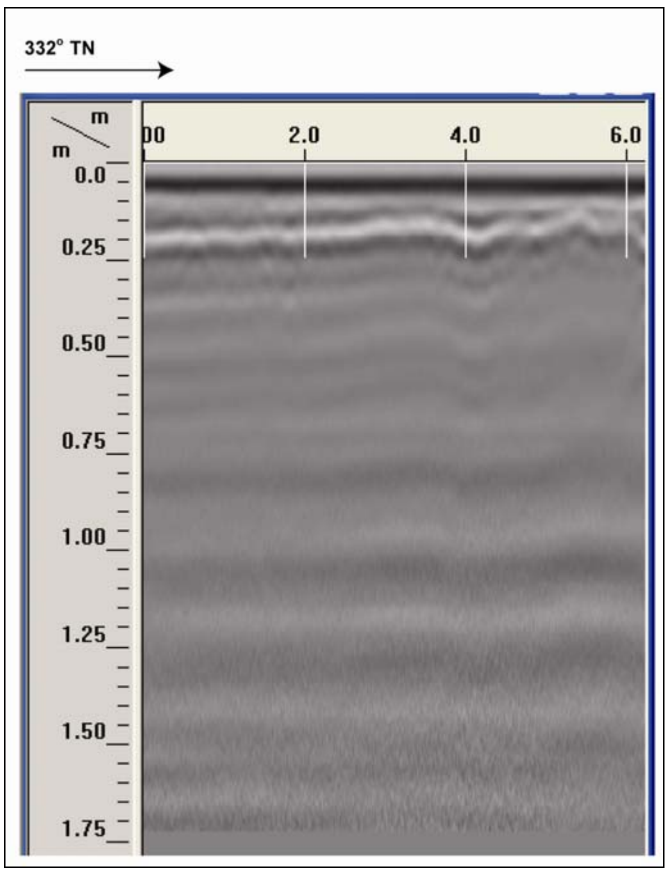

Figure 159. GPR profile of West Loch Station Makai Test Trench 6

Column Test 9 (C-9)

Orientation	333° TN
Length	2 m
Width	2 m
Maximum Depth	1.75 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill Horizon; 10 YR 3/2, very dark grayish brown; silt loam; weak, medium, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary;
Ib	25-50	Basalt gravel. Cushion for subsurface utilities.
Ic	50-160	Fill Horizon; 10 YR 3/2.5, very dark grayish brown, dark brown; silty clay; weak, fine, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; abrupt smooth lower boundary;
Id	160-175	Basalt gravel. Cushion for subsurface utilities.

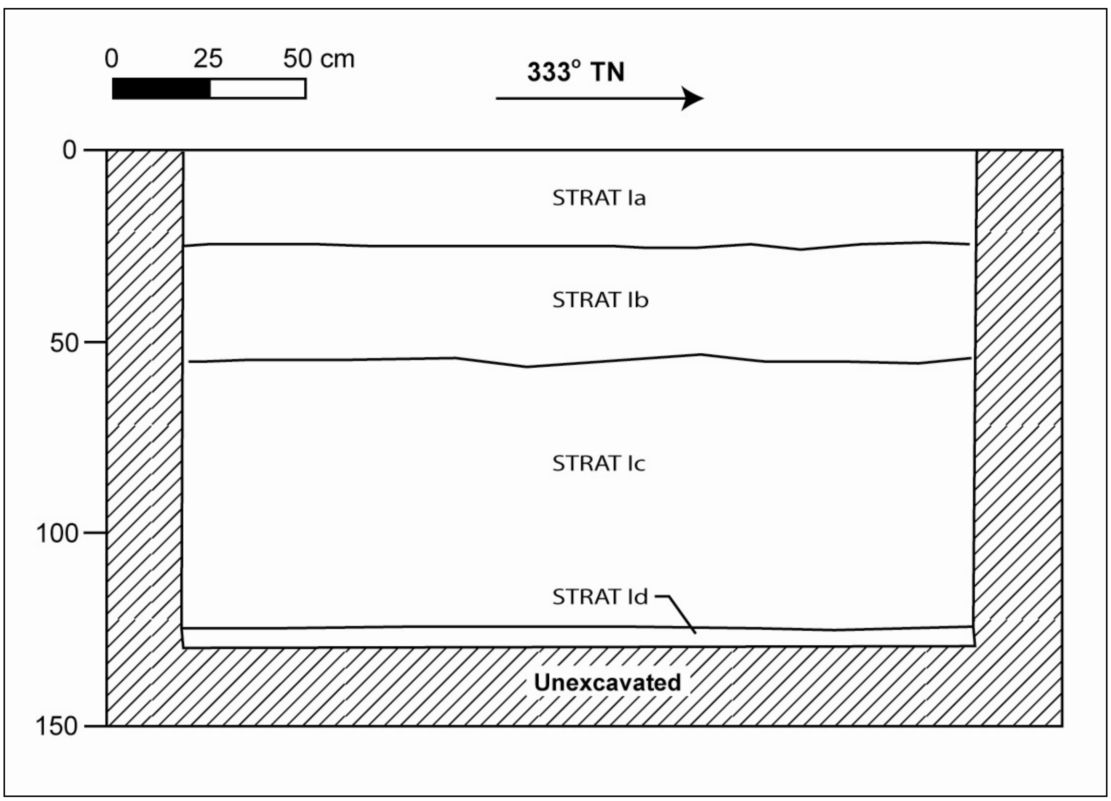

Figure 160. Profile of Column Test 9 (C-9)

Figure 161. Photograph of Column Test 9 (C-9), view to west

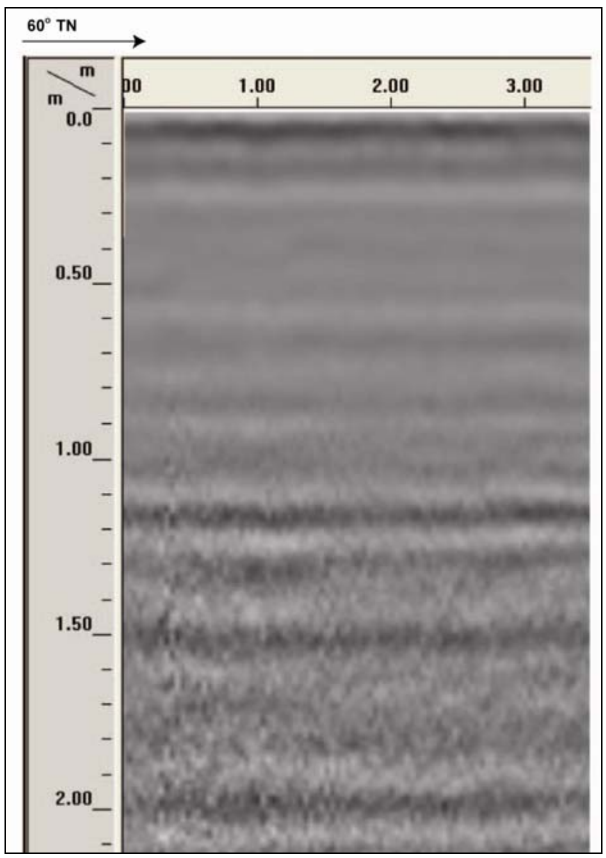

Figure 162. GPR profile of Column Test 9 (C-9)

Column Test 10 (C-10)

Orientation	243° TN
Length	2 m
Width	2 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-15	Concrete sidewalk
Ib	15-50	Basalt gravel base course
Ic	50-160	Fill Horizon; 10 YR 3/2.5, very dark grayish brown; silty clay, clay loam; moderate, fine, medium, granular structure; slightly hard dry consistency; non-plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography.
II	160-175	10 YR 3/3, dark brown; clay loam; weak, fine, crumb structure; friable moist consistency; non-plastic; no cementation; terrestrial origin

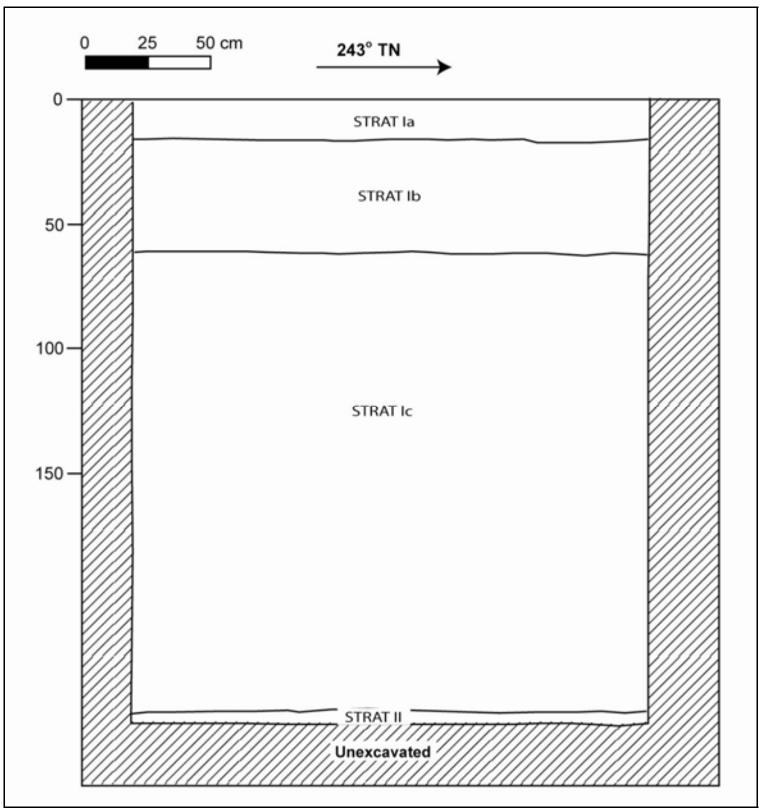

Figure 163. Profile of Column Test 10 (C-10)

Figure 164. Photograph of Column Test 10 (C-10), view to southeast

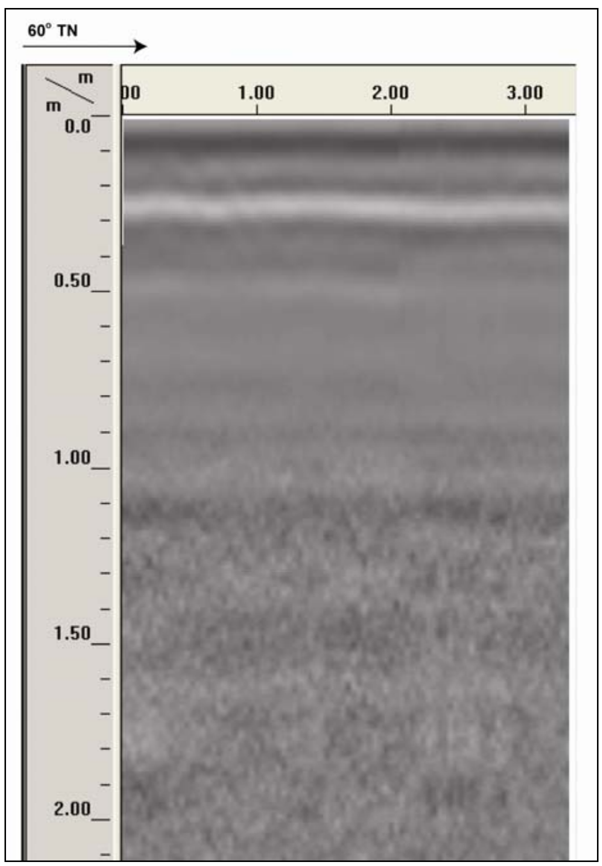

Figure 165. GPR profile of Column Test 10 (C-10)

4.9 Construction Sheet RW009

Construction Sheet RW009 includes a 2,100 ft (0.6 km) segment of the proposed transit corridor (Figure 166). Two column test pits (C-11 & C-12) were excavated within the area delineated by Construction Sheet RW009.

4.9.1 Pedestrian Inspection

The route for the transit corridor through Waipahu is aligned with the landscaped median of Farrington Highway with the surrounding area being heavily populated and developed (Figure 167). The roadway median is landscaped with a variety of trees, shrubs, and grasses. Structures in the surrounding area range from small residential homes and low rise apartments to local ‘strip malls’ and shopping centers. Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.9.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. The GPR was able to delineate stratigraphic interfaces at both test areas, and subsurface utilities observed during the test excavation of column test 11 (C-11) were not located (Figure 168 thru Figure 173). Additionally, the maximum “visibility” within the study area ranged from 100 to 150 cm below the surface. It is believed that the environmental conditions (i.e. soil chemistry) present within Construction Sheet RW009 caused the sediments to be too conductive causing the radar waves to disperse, resulting in limited depth “visibility” and inaccurate data output. Thus it appears that the area defined by Construction Sheet RW009 is not viable for an accurate GPR survey. This conclusion is consistent the NRCS, which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

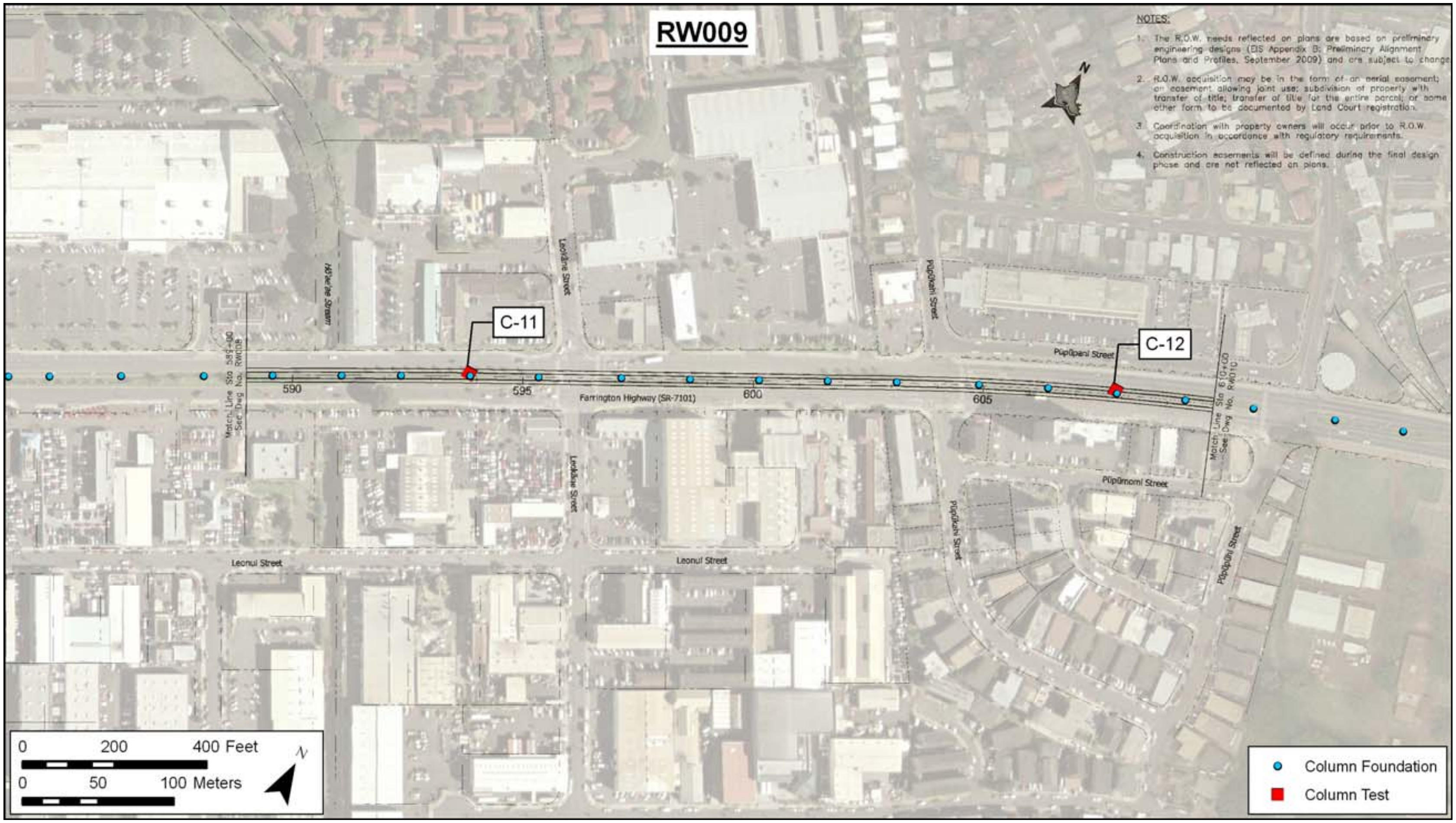

Figure 166. Construction Sheet RW009 showing the location of test excavations

Figure 167. Photograph depicting general surroundings along Farrington Highway through Waipahu showing high urbanization of area

4.9.3 Subsurface Testing

4.9.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW009 (see Figure 166). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 168 to Figure 173).

In general the observed and documented stratigraphy consisted of varying layers of imported fill, associated with median landscaping and subsurface utility installation, overlying naturally deposited alluvial sediment. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.9.3.2 Excavation Documentation

Column Test 11 (C-11)

Orientation	334° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.9 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill; 5 YR 3/2, dark reddish brown; silty clay; moderate, fine, crumb structure; loose dry consistency; slightly plastic; no cementation; abrupt smooth lower boundary. Landscaping topsoil for median foliage, root zone extends to ~45 cmbsl
Ib	25-40	Fill; 10 R 4/4, weak red; clay loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; Agricultural soil for hedge growing along median.
Ic	40-90	Fill; 7.5 YR 5/3, brown; silt loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; Natural silt loam previously disturbed during modernization of area
II	90-190	10 YR 4/2, 10 YR 4/1, dark grayish brown, dark gray; silt, hard dry consistency; non-plastic; weak cementation; natural basalt layer with silt pockets, upper 50cm composed of eroded/weathered basalt

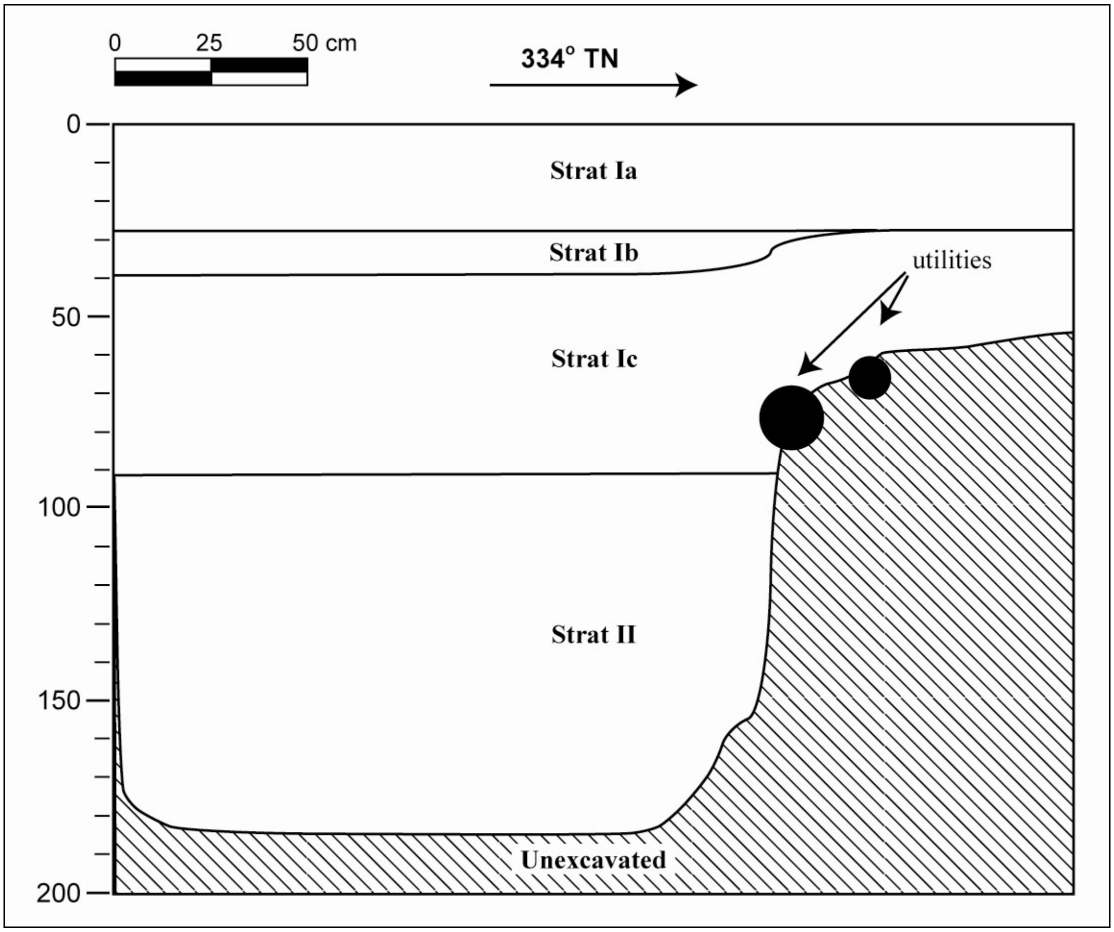

Figure 168. Profile of Column Test 11 (C-11)

Figure 169. Photograph of Column Test 11 (C-11), view to southwest

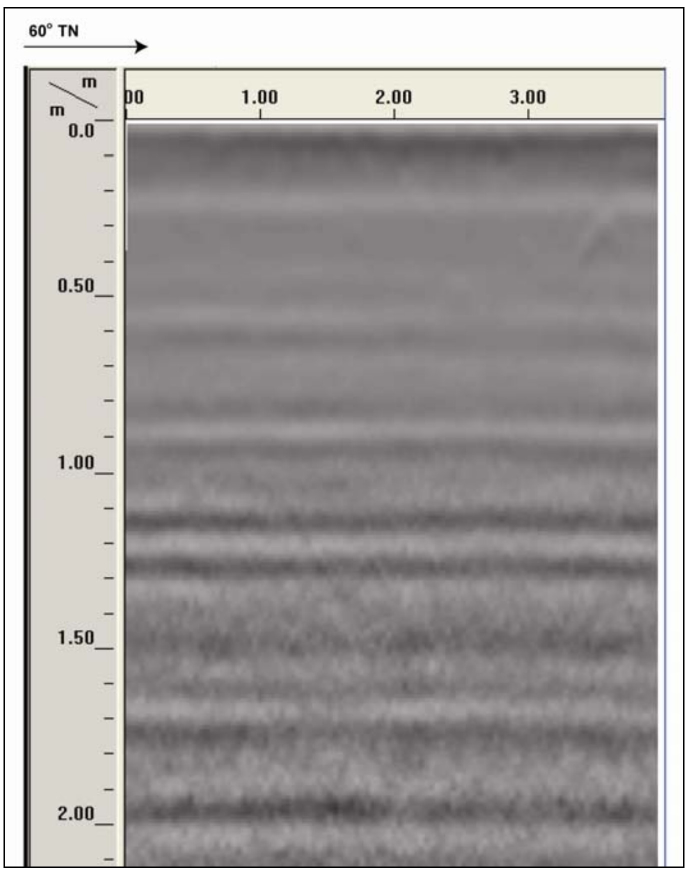

Figure 170. GPR profile of Column Test 11 (C-11)

Column Test 12 (C-12)

Orientation	324° TN
Length	2 m
Width	2 m
Maximum Depth	3 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill; 5 YR 3/3, dark reddish brown; silty clay loam; moderate, medium, crumb structure; firm moist consistency; plastic; no cementation; abrupt smooth lower boundary; organic layer with vegetation, heavy root material, landscaping fill
Ib	25-40	Fill; 10 YR 4/2, dark grayish brown; garvelly, sand; structureless, loose moist consistency; no cementation; abrupt smooth lower boundary; gravel/sand base coarse
II	90-190	10 YR 3/3, dark brown; silty clay; moderate, medium, crumb structure; firm moist consistency; plastic; no cementation; back-filled natural sediments

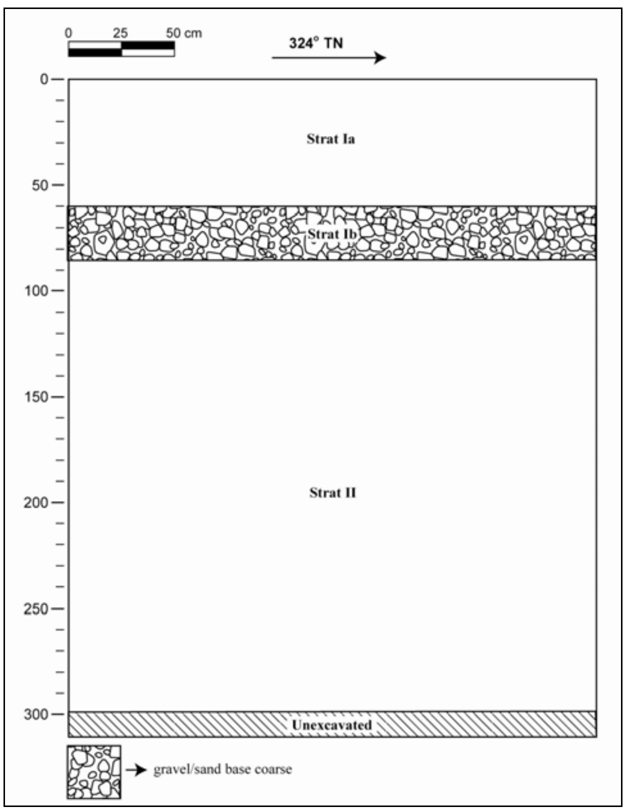

Figure 171. Profile of Column Test 12 (C-12)

Figure 172. Photograph of Column Test 12 (C-12), view to southwest

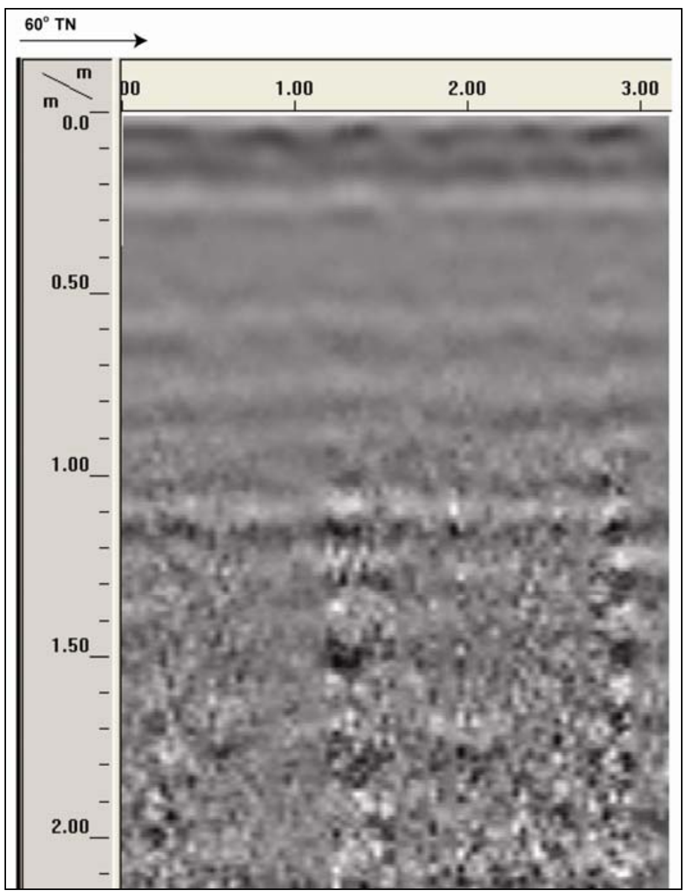

Figure 173. GPR profile of Column Test 12 (C-12)

4.10 Construction Sheet RW010

Construction Sheet RW010 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor (Figure 174). Two column test pits (C-13 & C-14) were excavated within the area delineated by Construction Sheet RW010.

4.10.1 Pedestrian Inspection

This area is located within the middle of Waipahu with the surrounding area being highly urbanized. The transit route is still located along the middle of Farrington Highway with various small businesses (shops, restaurants), low-rise apartments, and small subdivisions being located along both sides of the road (Figure 175). Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.10.2 GPR Survey

Prior to the excavation of column test pits, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey of column test pit C-13 identified a single subsurface anomaly that likely corresponded to a buried pipe that was observed during test excavation (Figure 176 & Figure 178).

The GPR survey of column test pit C-14 was inconclusive. This is due to the fact that the stratigraphy of C-14 consisted of fairly uniform sediments containing no features or foreign objects (Figure 179 & Figure 180). As a result the coinciding GPR data was also fairly uniform, indicating no subsurface anomalies or stratigraphic layers present in the test area (Figure 181).

4.10.3 Subsurface Testing

4.10.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW010 (see Figure 174). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavations, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 176 to Figure 181).

In general the observed and documented stratigraphy consisted of varying layers of imported fill, associated with median landscaping and subsurface utility installation, overlying naturally deposited alluvial sediment. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

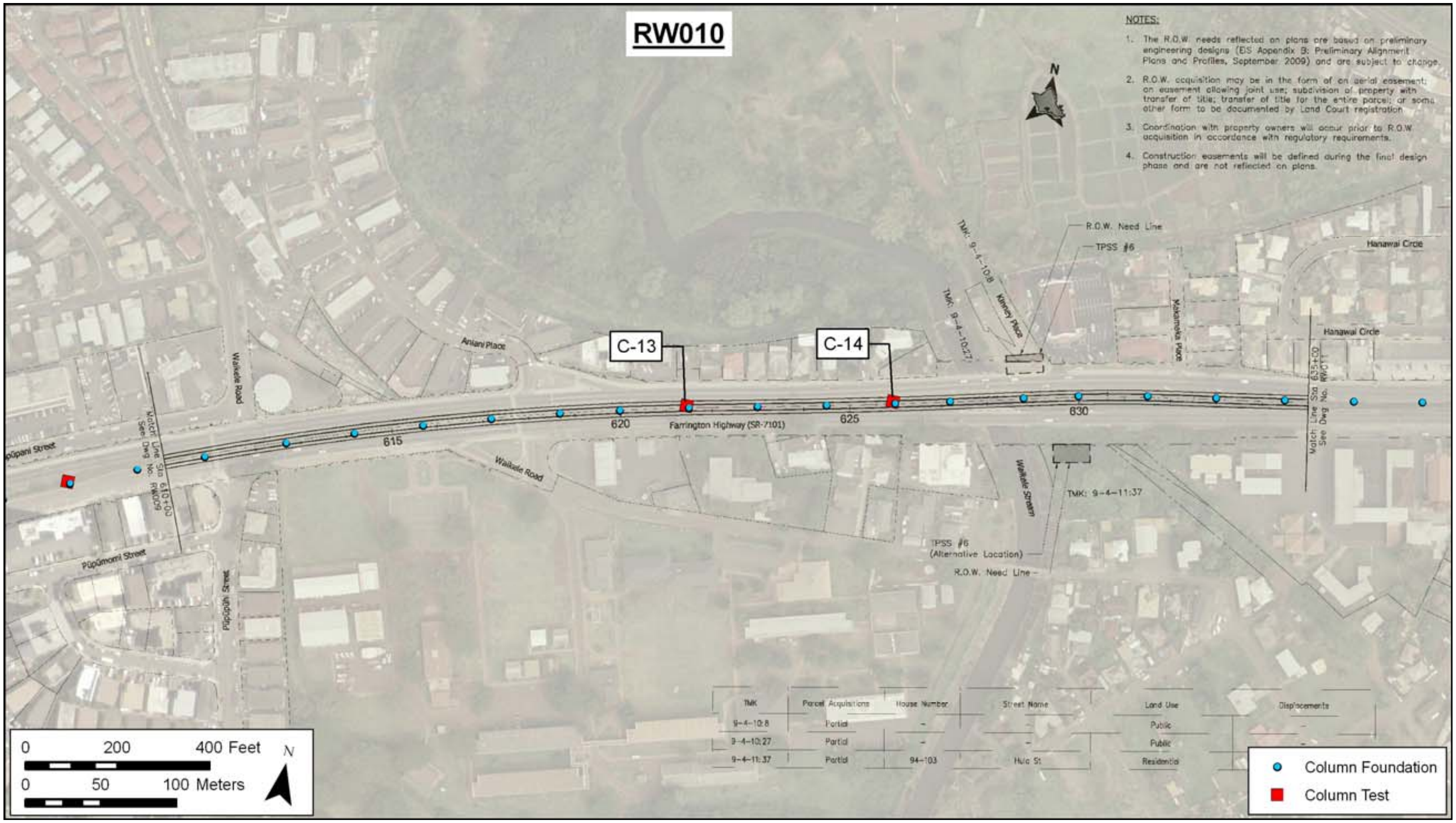

Figure 174. Construction Sheet RW010 showing the location of test excavations

Figure 175. Photo of existing conditions along transit route as it follows Farrington Highway through Waipahu

4.10.3.2 Excavation Documentation

Column Test 13 (C-13)

Orientation	065° TN
Length	2 m
Width	2 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-60	Fill; 5 YR 3/2, dark reddish brown; clay loam; weak, fine, crumb structure; loose moist consistency; non-plastic; no cementation; clear smooth lower boundary; Landscaping fill, excavated unknown cast-iron utility line at 15cm on east side of trench, cont. to dig on west side
II	60-260	7.5 YR 3/3, dark brown; clay loam; moderate, medium, crumb structure; friable moist consistency; non-plastic; no cementation; No culturaly sterile natural sediment.

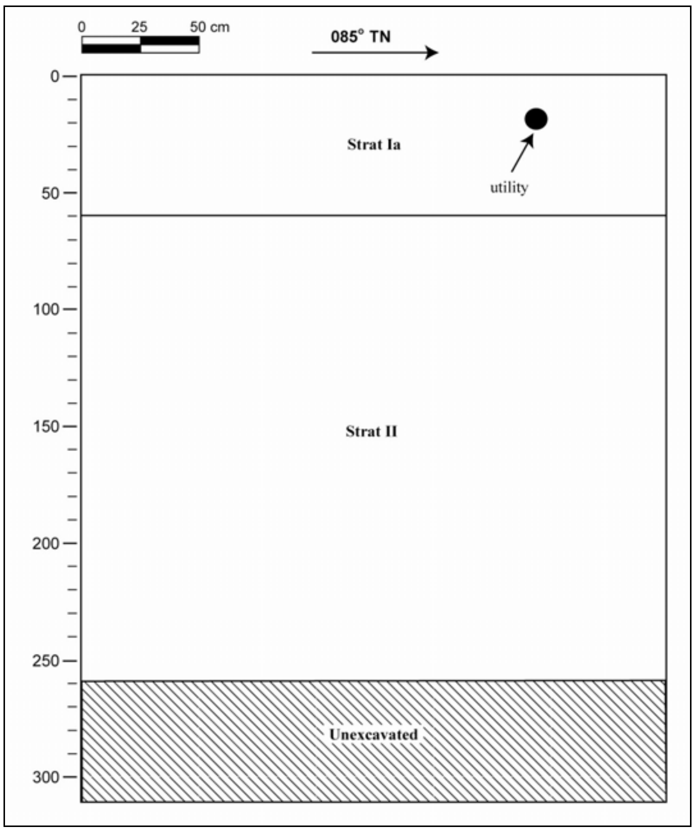

Figure 176. Profile of Column Test 13 (C-13)

Figure 177. Photograph of Column Test 13 (C-13), view to west

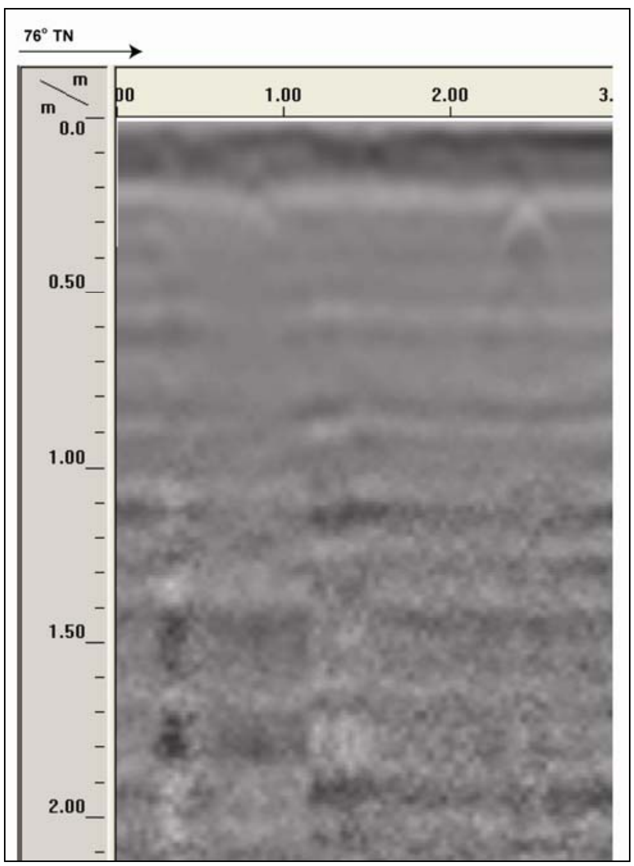

Figure 178. GPR profile of Column Test 13 (C-13)

Column Test 14 (C-14)

Orientation	256° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill; 7.5 YR 4/2, brown; silty clay loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; topsoil for landscaping
Ib	30-60	Fill; 10 YR 4/4, dark yellowish brown; silt; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; terrigenous fill layer containing historic debris
II	60-260	7.5 YR 4/6, strong brown; silt loam; moderate, fine, crumb, blocky structure; loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; natural sediment goes from fine grain at top to blocky at BOE, overlies basalt

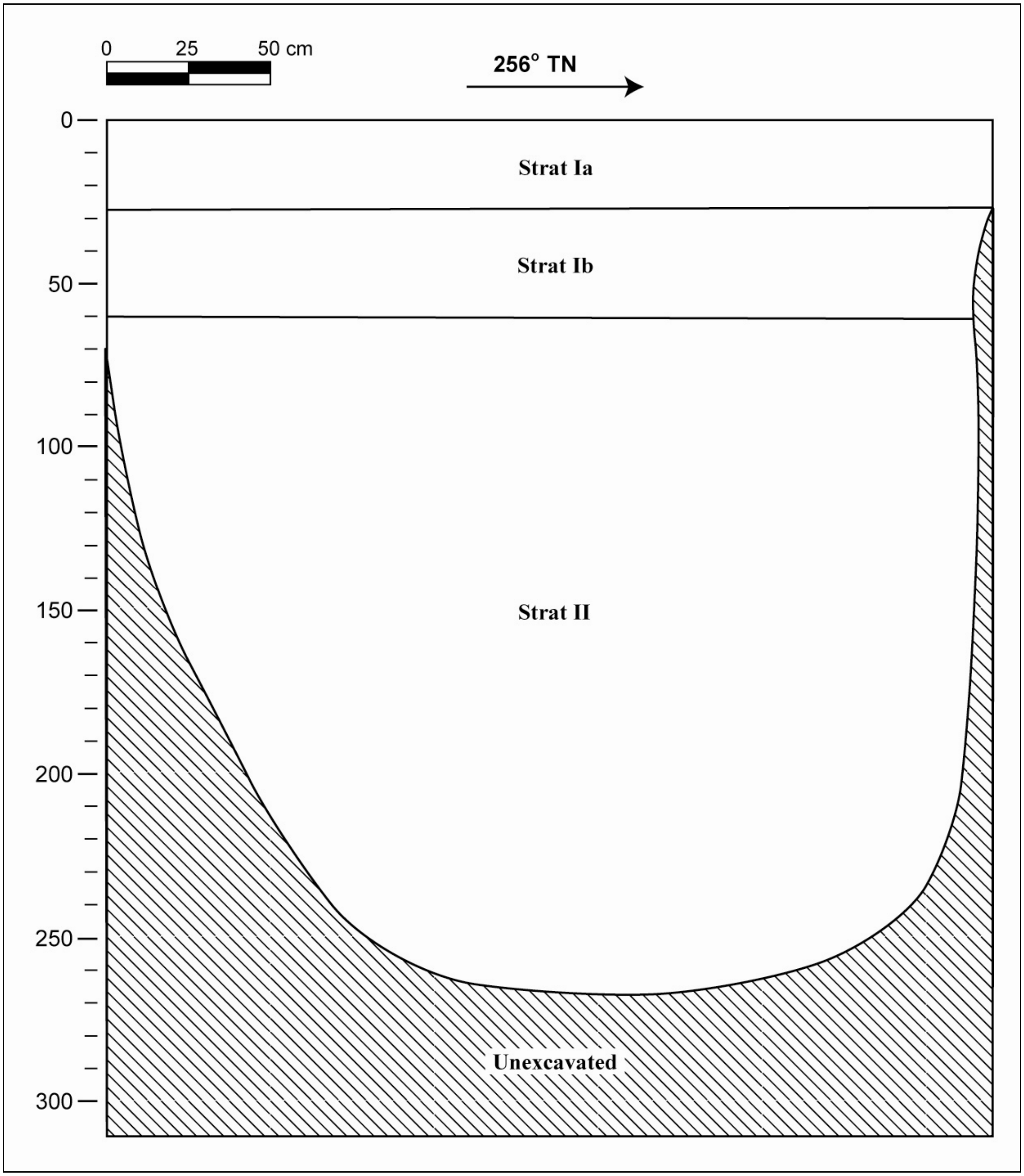

Figure 179. Profile of Column Test 14 (C-14)

Figure 180. Photograph of Column Test 14 (C-14), view to south

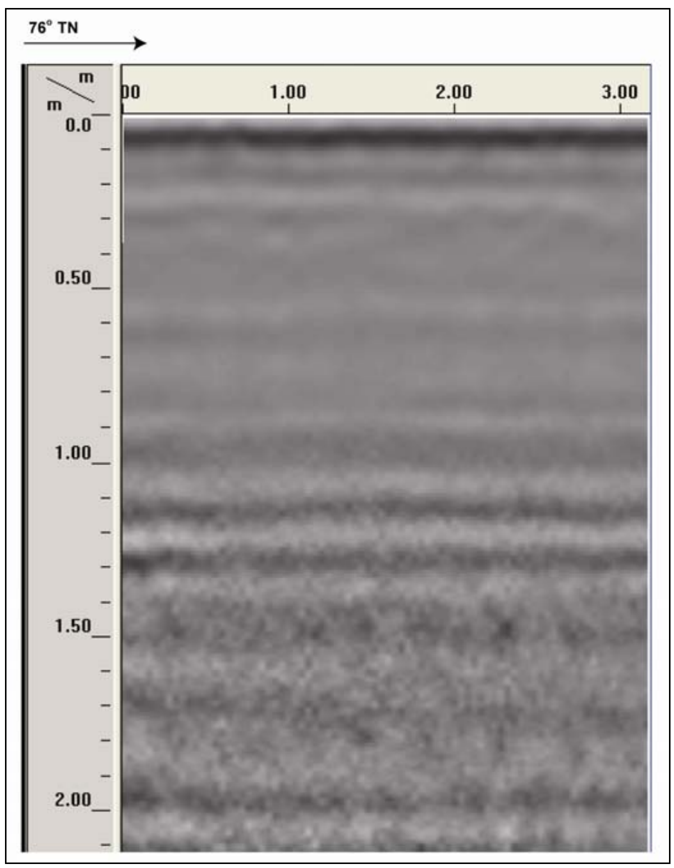

Figure 181. GPR profile of Column Test 14 (C-14)

4.11 Construction Sheet RW011

Construction Sheet RW011 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor, and includes the proposed Waipahu Transit Center Station (Figure 182). 12 test trenches were excavated at the station (Figure 183). Additionally, 7 column test pits (C-21 to C-27) were also excavated (see Figure 182 & Figure 183), totaling 19 test excavations within Construction Sheet RW011.

4.11.1 Pedestrian Inspection

The surrounding area detailed on this construction sheet remains within the highly urbanized area of Waipahu with the environment consisting of various types of structures including low-rise buildings, small housing areas, and some commercial/industrial businesses. The site for the proposed Waipahu Transit Center Station is situated in this segment with a small business located on the *mauka*/northern side of the road (Figure 184). The *makai* /south section of the station was formerly occupied by a used car lot (Figure 185). Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.11.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. The GPR was able to locate subsurface objects (a concrete utility jacket and buried asphalt fragments) in Waipahu Transit Center Station Mauka trenches 1 (Figure 186 & Figure 188) and 6 (Figure 201 & Figure 203), but was unable to identify subsurface utilities in column test C-21 (Figure 222 & Figure 224) and C-25 (Figure 234 & Figure 236). It is believed that the presence of thick wet clay deposits in this area was the primary factor to the inconsistent results of the GPR data. Clay soils (especially those that are inundated) are noted as being very conductive, resulting in radio wave attenuation at shallow depths causing limited depth “visibility” and inaccurate GPR data collection (Conyers 2004).

The GPR survey was also unable to define the stratigraphic interfaces within any of the test areas. The inability to discern stratigraphic interfaces in this area is likely due to the presence of thick clay deposits, as well as varying stratums with similar consistencies.

Thus it has been concluded that GPR survey results are inconclusive within the area defined by Construction Sheet RW011. The environmental conditions (i.e. thick clay deposits) present within this area caused the sediments to be too conductive causing the radar waves to attenuate, resulting in limited depth “visibility” and inaccurate data output. This conclusion is consistent the NRCS, which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

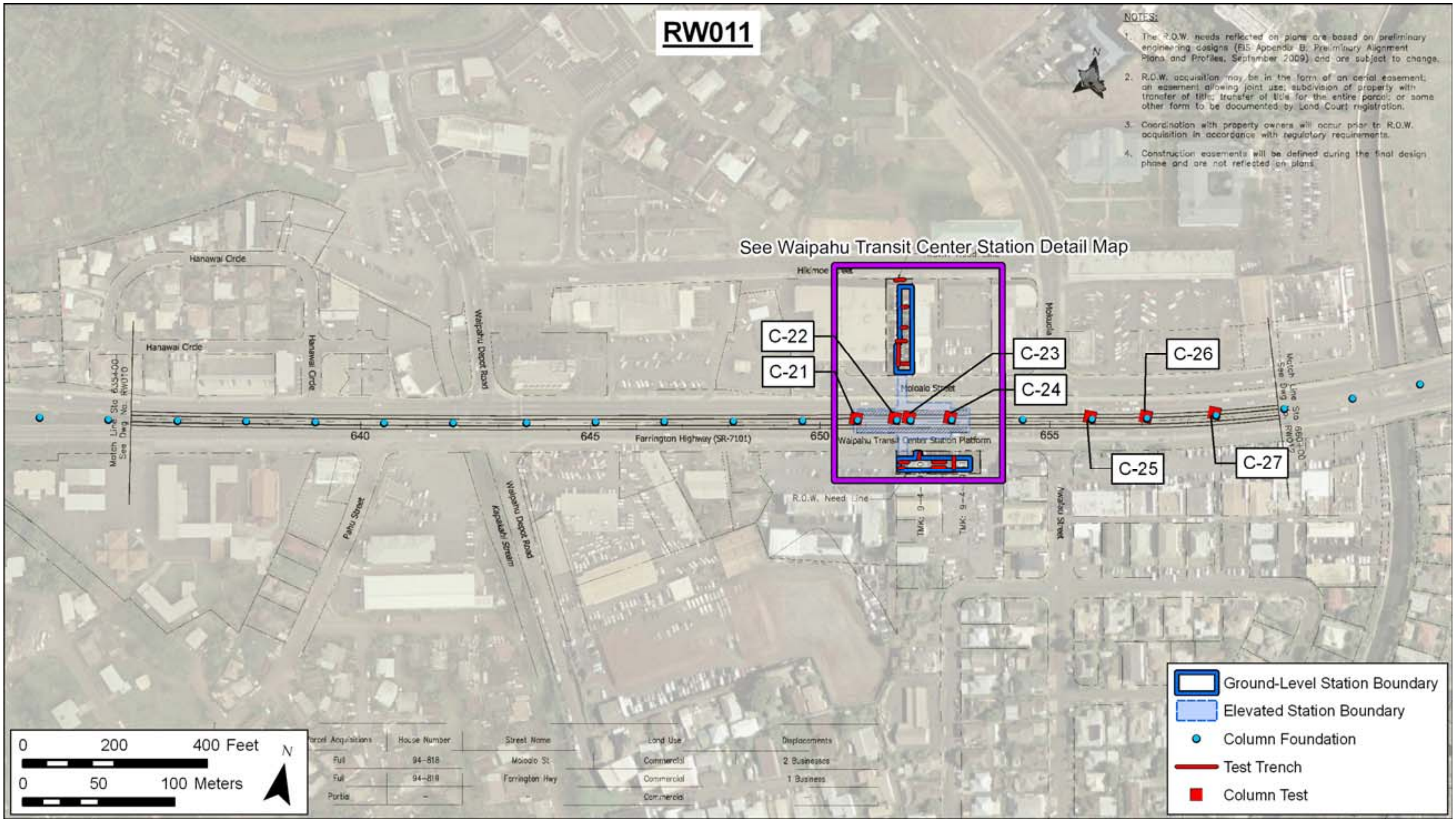

Figure 182. Construction Sheet RW011 showing the location of test excavations

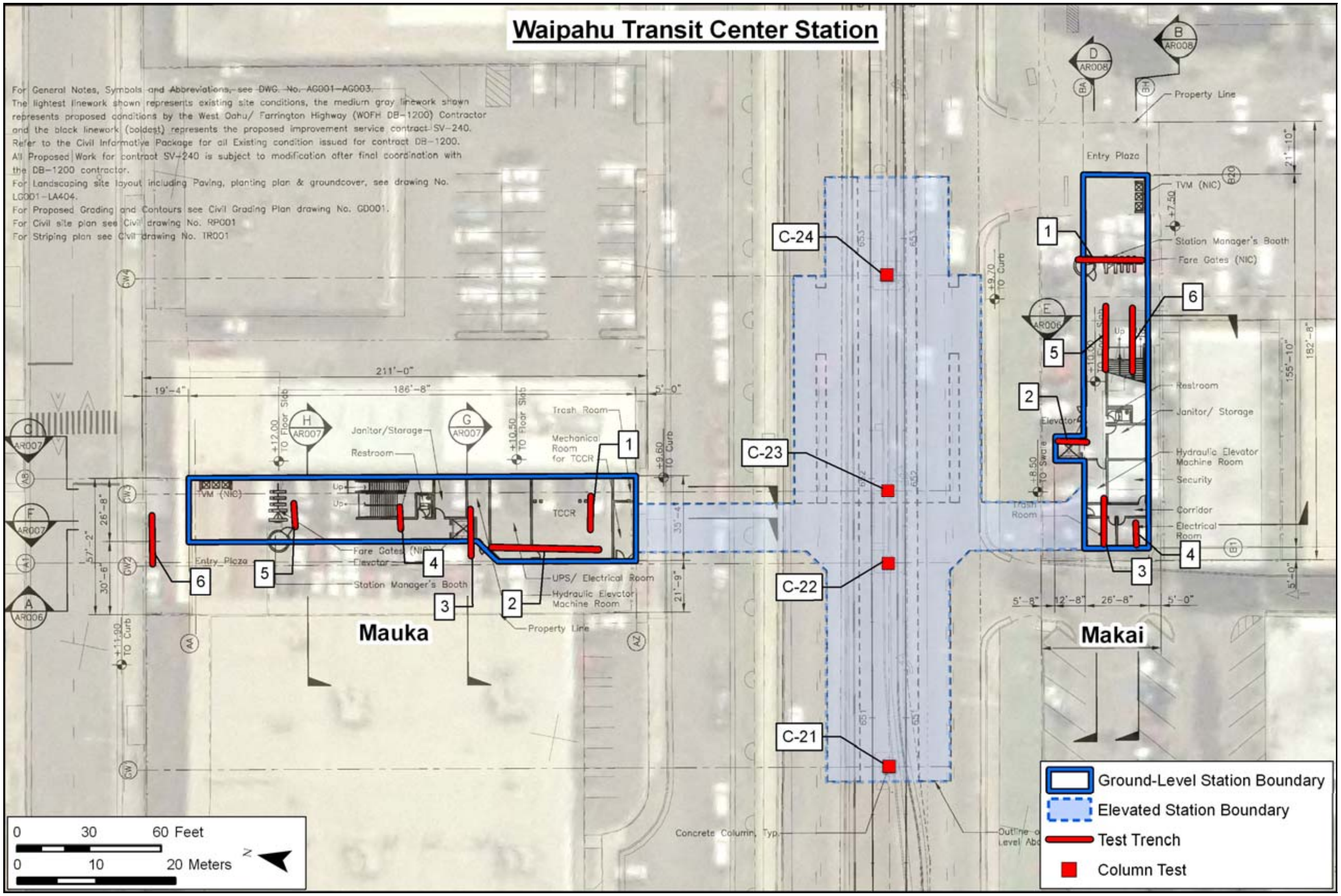

Figure 183. Waipahu Transit Center Station floor plan showing the location of test trenches

Figure 184. Photo of existing conditions along transit route as it follows Farrington Highway through the highly urbanized area of Waipahu, with location of Waipahu Transit (*mauka*/north side) in background

Figure 185.Photograph showing the highly urbanized surroundings of the Waipahu area along the transit route extends through (along Farrington Highway), with site for *makai*/south side of the Waipahu station in background

4.11.3 Subsurface Testing

4.11.3.1 Stratigraphic Summary

Nineteen (19) test excavations were placed within the area delineated by Construction Sheet RW011 (see Figure 182 & Figure 183). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 186 to Figure 242).

In general the observed and documented stratigraphy consisted of varying imported fill layers overlying naturally deposited alluvial sediment inundated with water, suggesting the area was once a marsh prior to urban development. The fill layers appear to be associated with two distinct events: 1) mass grading and filling associated with land reclamation, and 2) asphalt parking lot construction. Of note was the presence of reddish orange mottling and charcoal flecking within the marsh sediments (Stratum II) observed at the *makai* (southern) portion of the proposed Waipahu Station (see Figure 183 and Figure 204 to Figure 221). These inclusions are suggestive that agriculture, specifically taro cultivation, had occurred in this area prior to urban development. A review of LCA documentation for the area confirmed that *lo‘i* (wetland taro fields) were present in the area. Accordingly, the buried agricultural sediments were determined to be a cultural resource, and assigned as State Inventory of Historic Properties (SIHP) # 50-80-9-7751. A detailed description for SIHP 50-80-9-7751 is provided below in Section 6.18 Site Descriptions.

4.11.3.2 Excavation Documentation

Waipahu Transit Center Station Mauka Trench 1

Orientation	247° TN
Length	5.5 m
Width	0.8 m
Maximum Depth	2.4 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Basalt gravel base coarse
Ic	30-50	Fill; 7.5 YR 3/3, dark brown; clay loam; hard dry consistency; non-plastic; no cementation; clear smooth lower boundary; terrigenous fill material
Id	50-60	Fill; 2.5 YR 2.5/4, dark reddish brown; silty clay loam; weakly coherant dry consistency; friable moist consistency; slightly plastic; no cementation; clear smooth lower boundary; alluvial clay sediment used as fill
Ie	60-100	Fill; 7.5 YR 2.5/3, very dark brown; garvelly, clay; weak, loose dry consistency; loose moist consistency; non-plastic; no cementation; clear smooth lower boundary;
If	100-175	Fill; 10 YR 3/2, very dark grayish brown; loose moist consistency; non-sticky wet consistency; non-plastic; no cementation; large amount of oyster shell found in south end of trench; coral fragments; wire
II	175-240	10 YR 3/1, very dark gray; clay; weak, very plastic; no cementation; very plastic, dark gray/black clay, wetland sediments

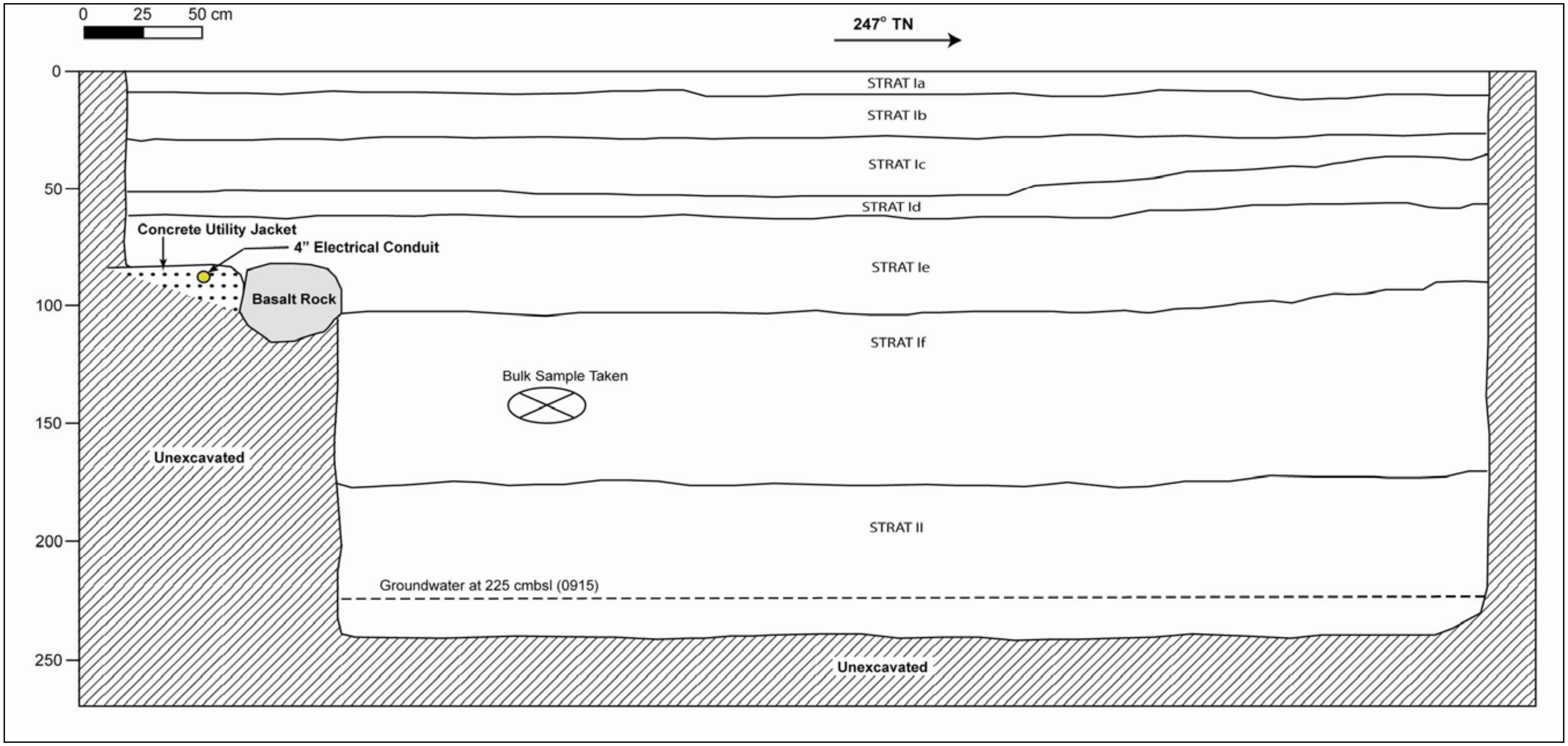

Figure 186. Profile of Waipahu Transit Center Station Mauka Trench 1

Figure 187. Photograph of Waipahu Transit Center Station Mauka Trench 1, view to south

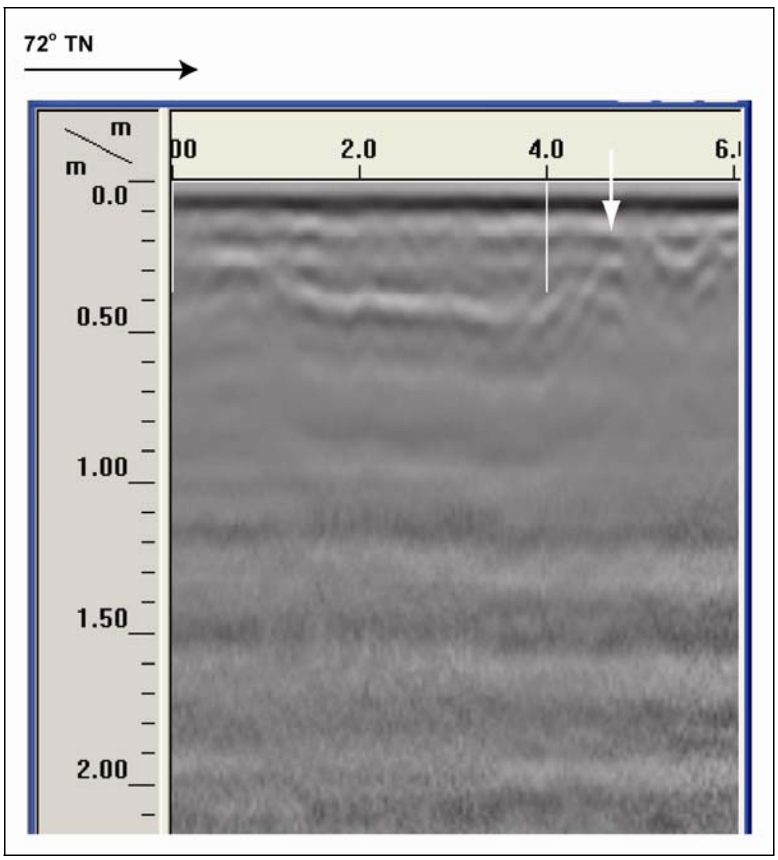

Figure 188. GPR profile of Waipahu Transit Center Station Mauka Trench 1

Waipahu Transit Center Station Mauka Trench 2

Orientation	165° TN
Length	14 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Basalt gravel base coarse
Ic	30-40	Fill; 10 YR 3/2, very dark grayish brown; clay loam; weak, medium, crumb structure; dry, weakly coherent consistency; slightly plastic; no cementation; terrestrial origin; clear boundary; smooth topography. Contains roots and land snalis.
Id	40-160	Fill; 2.5 YR 3/4, dark reddish brown; silty clay loam; weak, medium, crumb structure; dry, weakly coherent consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains roots. Imported fill used for land reclamation.
Ie	160-190	Fill; 2.5 YR 4/3, olive brown; sandy clay; structureless; moist, friable consistency; slightly plastic; no cementation; mixed origin; diffuse boundary; wavy topography. Contains marine shells and coral boulders. Imported fill used for land reclamation.
II	190-210	10 YR 3/1, very dark gray; clay loam; moderate, fine structure; wet, very sticky consistency; very plastic; no cementation. Wetland sediment at watertable.

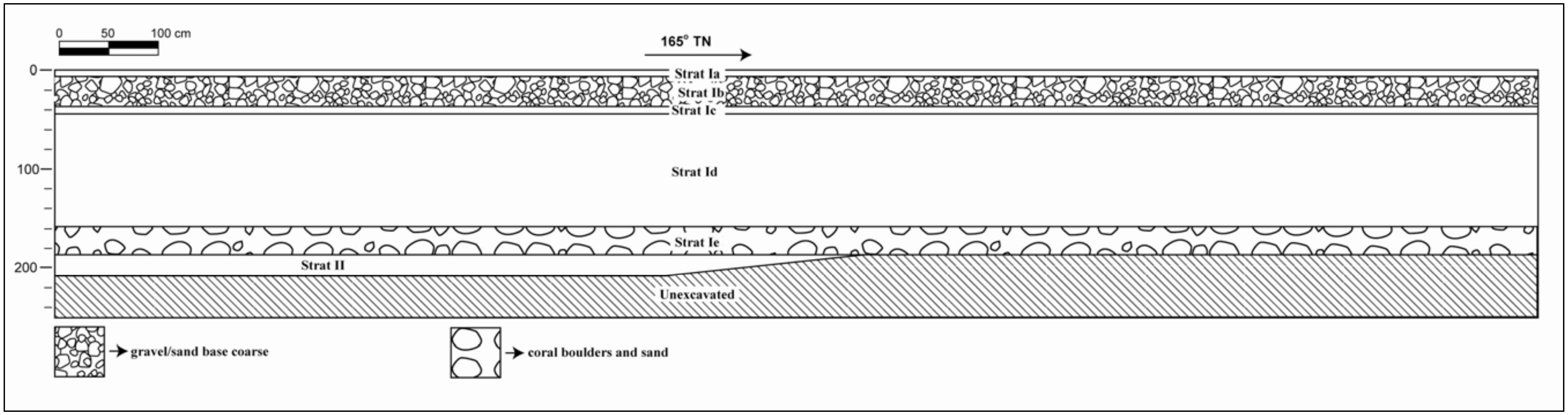

Figure 189. Profile of Waipahu Transit Center Station Mauka Trench 2

Figure 190. Photograph of Waipahu Transit Center Station Mauka Trench 2, view to east

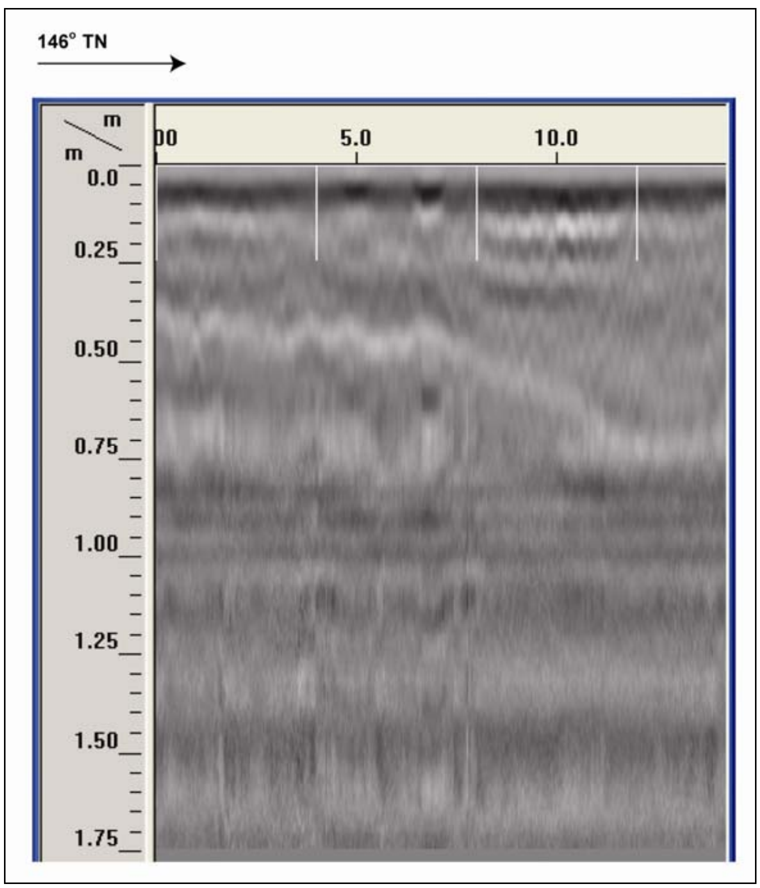

Figure 191. GPR profile of Waipahu Transit Center Station Mauka Trench 2

Waipahu Transit Center Station Mauka Trench 3

Orientation	074° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Basalt gravel base coarse
Ic	30-40	Fill; 10 YR 3/1, very dark gray; clay loam; moderate, medium, crumb structure; dry, friable consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography.
Id	40-130	Fill; 2.5 YR 3/6, dark red; silty clay loam; moderate, medium, crumb structure; moist, friable consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains roots.
Ie	130-150	Fill; 10 YR 2/1, black; clay loam; moderate, medium, crumb structure; moist, firm consistency; slightly plastic; no cementation; marine origin; clear boundary; wavy topography. Contains oyster shell.
If	150-200	Fill; 2.5 YR 4/4, olive brown; sandy clay; moderate, medium grandular structure; moist, firm consistency; slightly plastic; no cementation; marine origin; diffuse boundary; wavy topography.
II	200-270	10 YR 2/1, black; clay loam; moderate, fine crumb structure; wet, very sticky consistency; very plastic; strong cementation. Naturally deposited alluvial sediment. Inundated clay indicitive of former marsh envirnoment.

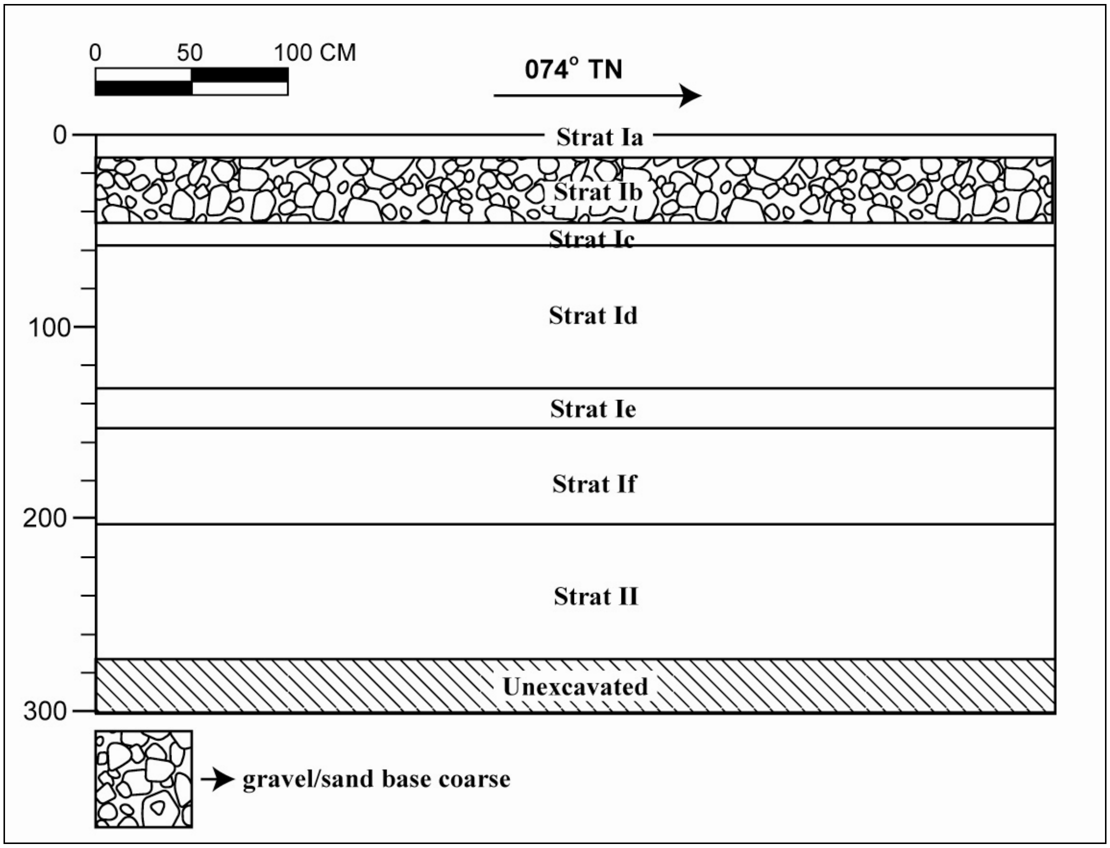

Figure 192. Profile of Waipahu Transit Center Station Mauka Trench 3

Figure 193. Photograph of Waipahu Transit Center Station Mauka Trench 3, view to north

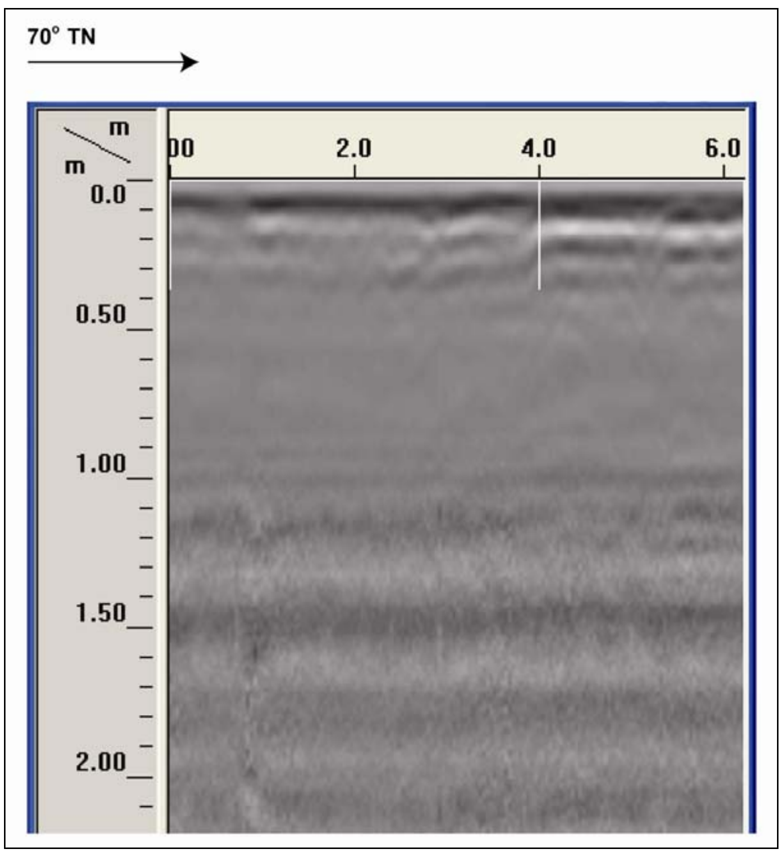

Figure 194. GPR profile of Waipahu Transit Center Station Mauka Trench 3

Waipahu Transit Center Station Mauka Trench 4

Orientation	065° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-70	10 YR 5/2, grayish brown; clay loam; structureless; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains 50% basalt gravel. Base course for asphalt surface.
Ic	50-190	5 YR 4/4, reddish brown; silty clay; moderate, fine, crumb structure; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; wavy topography.
Id	190-205	10 YR 4/4, dark yellowish brown; clay loam; weak, fine, crumb structure; dry, loose consistency; slightly plastic; no cementation; mixed origin; abrupt boundary; smooth topography. Fill sediments containing coral and basalt aggragate to prevent ground water seepage.
II	205-270	Gley 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; wet, very sticky consistency; very plastic; no cementation; terrestrial. Naturally deposited wetland sediments indicating area consisted of a marsh prior to modern urban development.

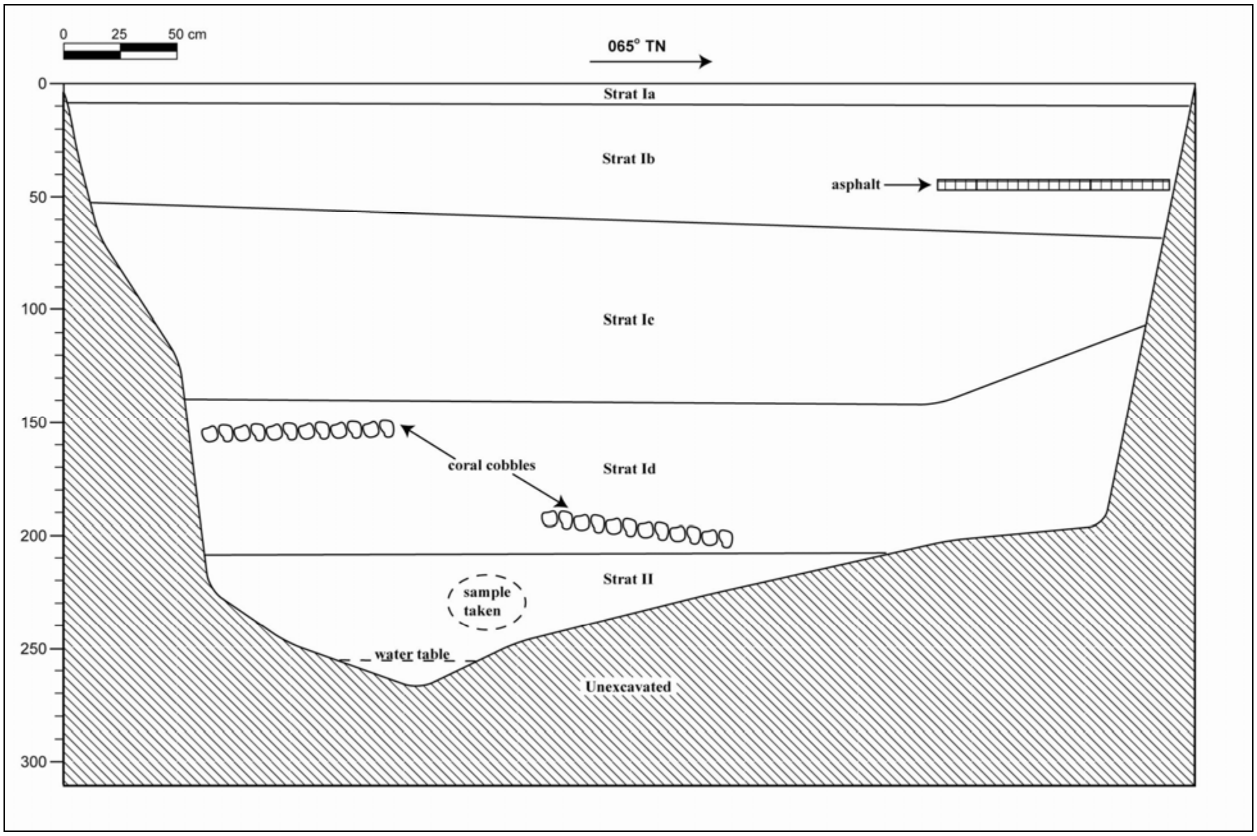

Figure 195. Profile of Waipahu Transit Center Station Mauka Trench 4

Figure 196. Photograph of Waipahu Transit Center Station Mauka Trench 4, view to northwest

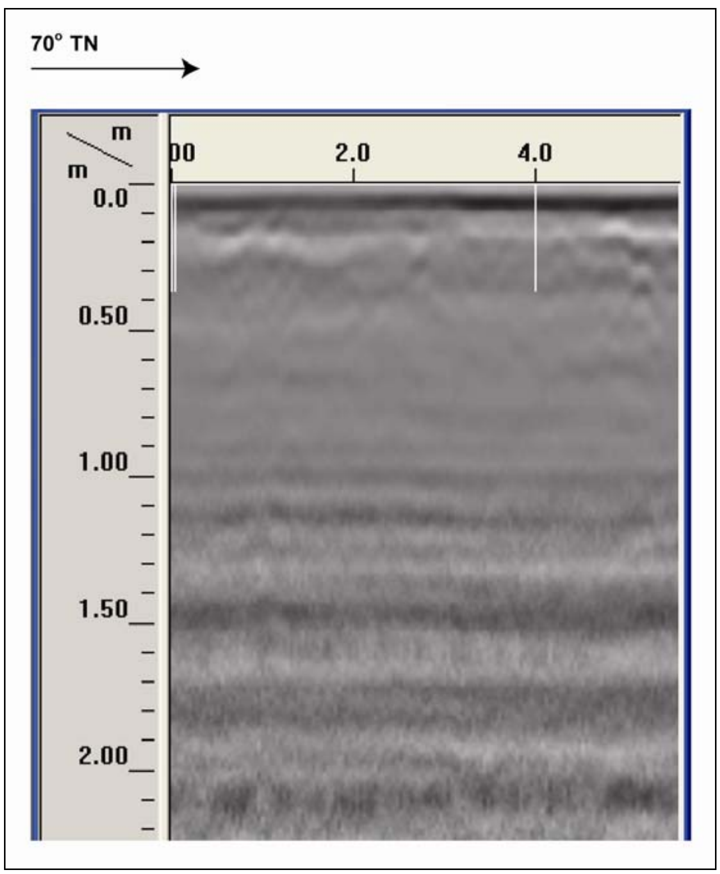

Figure 197. GPR profile of Waipahu Transit Center Station Mauka Trench 4

Waipahu Transit Center Station Mauka Trench 5

Orientation	082° TN
Length	4.5 m
Width	0.8 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-50	Fill; 10 YR 5/2, grayish brown; clay loam; structureless; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains 50% basalt gravel. Base course for asphalt surface.
Ic	50-200	Fill; 5 YR 4/4, reddish brown; silty clay; moderate, fine, crumb structure; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; wavy topography.
II	200-270	Gley 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; wet, very sticky consistency; very plastic; no cementation; terrestrial. Naturally deposited wetland sediments indicating area consisted of a marsh prior to modern urban development.

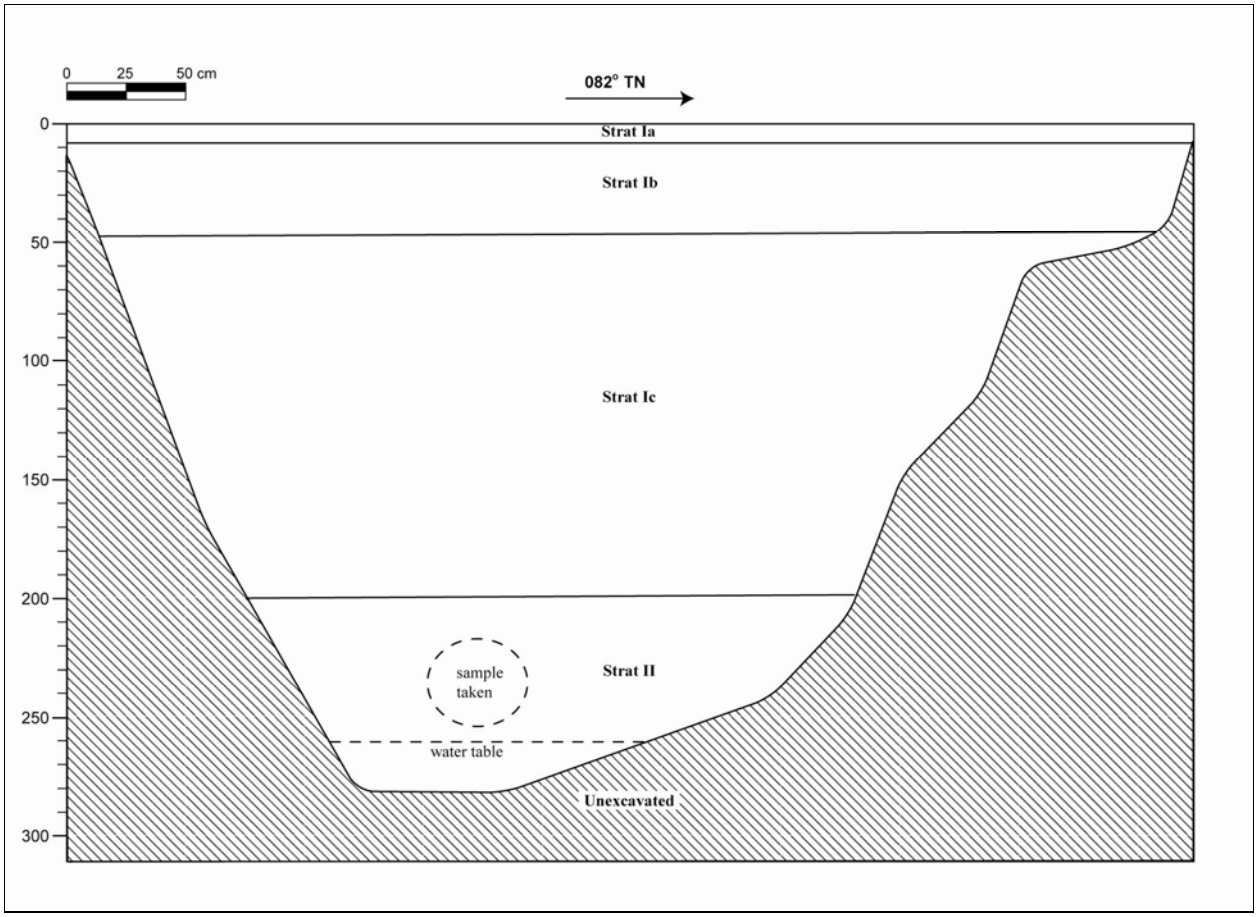

Figure 198. Profile of Waipahu Transit Center Station Mauka Trench 5

Figure 199. Photograph of Waipahu Transit Center Station Mauka Trench 5, view to north

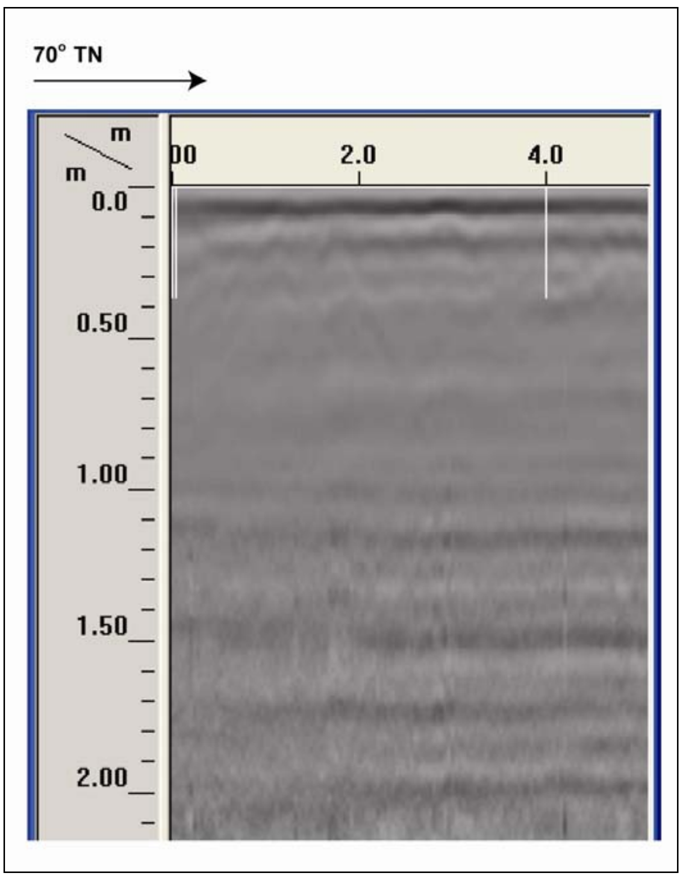

Figure 200. GPR profile of Waipahu Transit Center Station Mauka Trench 5

Waipahu Transit Center Station Mauka Trench 6

Orientation	249° TN
Length	6 m
Width	0.8 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill; 10 YR 4/2, dark grayish brown; asphalt, silt loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Surface grading fill with broken asphalt slab and modern debris - plastic bottles, cans, insulation (foam). Concrete, gravel - roots/rootlings from weeds and grass, small to med. Cobbles
Ib	40-50	Fill; 10 R 4/6, red; silty clay; moderate, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Alluvial fill overlying gravel fill
Ic	50-60	Fill; 10 YR 5/1, gray; gravel; structureless, loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Gravel fill possibly used for drainage
Id	60-230	Fill; 10R 3/6, red; silty clay; moderate, fine, crumb structure; loose dry consistency; friable moist consistency; slightly plastic; no cementation; very abrupt smooth lower boundary; Silty clay alluvium appears redeposited with layer of basalt cobbles and boulders at base (207 - 226cm bsl)
II	230-250	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; firm moist consistency; very sticky wet consistency; very plastic; no cementation; wetland clay contains decomposing roots/rootlings, ground water at 250cmbs, sampled at 235 - 245cm bsl.

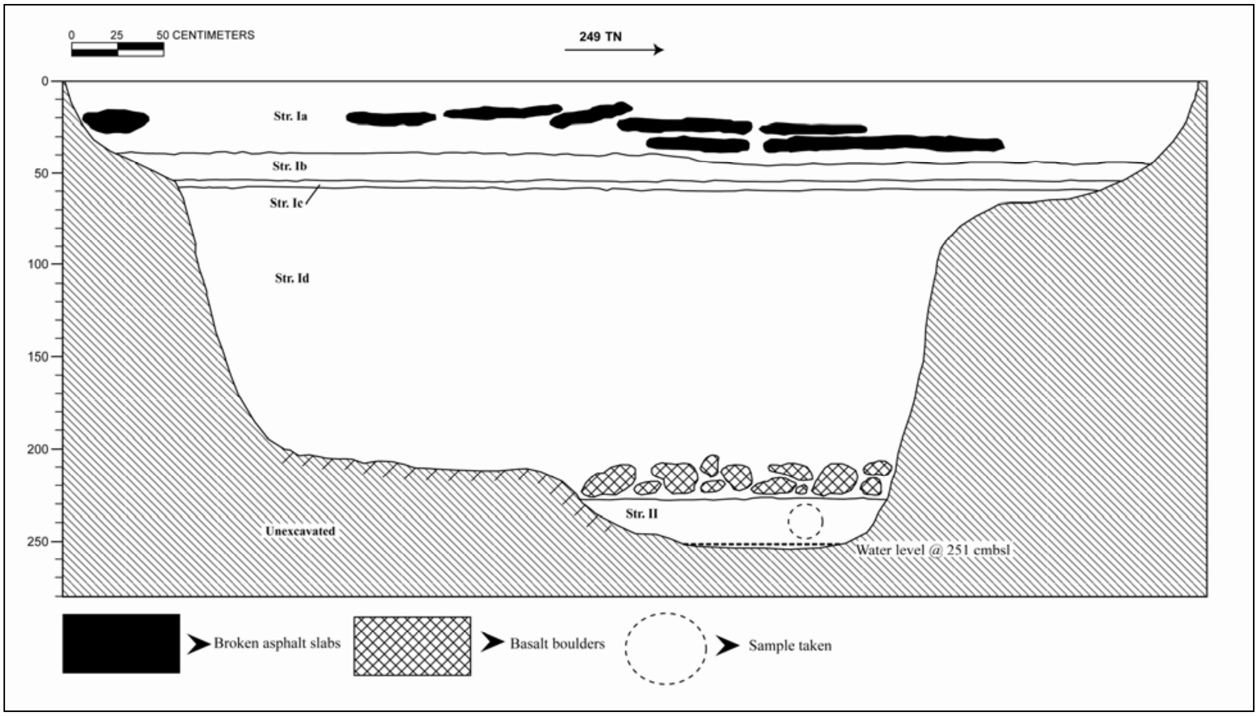

Figure 201. Profile of Waipahu Transit Center Station Mauka Trench 6

Figure 202. Photograph of Waipahu Transit Center Station Mauka Trench 6, view to southeast

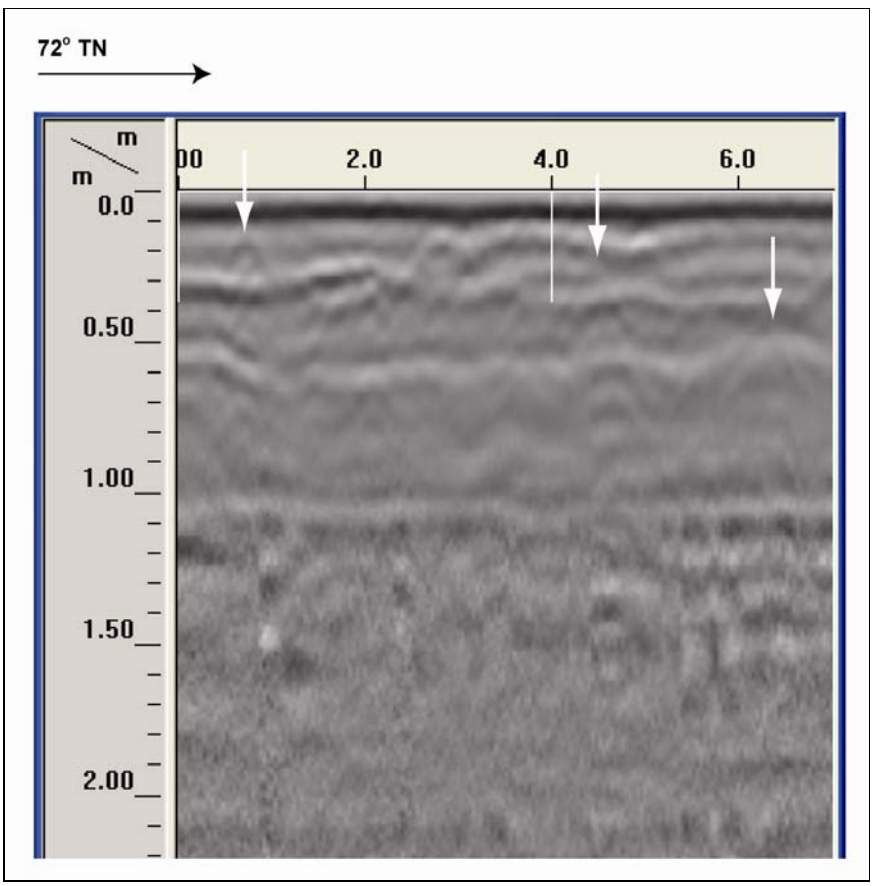

Figure 203. GPR profile of Waipahu Transit Center Station Mauka Trench 6

Waipahu Transit Center Station Makai Trench 1

Orientation	170° TN
Length	8 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Crushed coral fill
Ic	30-100	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface of underlying wetland sediments, indicative of land reclamation construction techniques.
II	100-200	10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

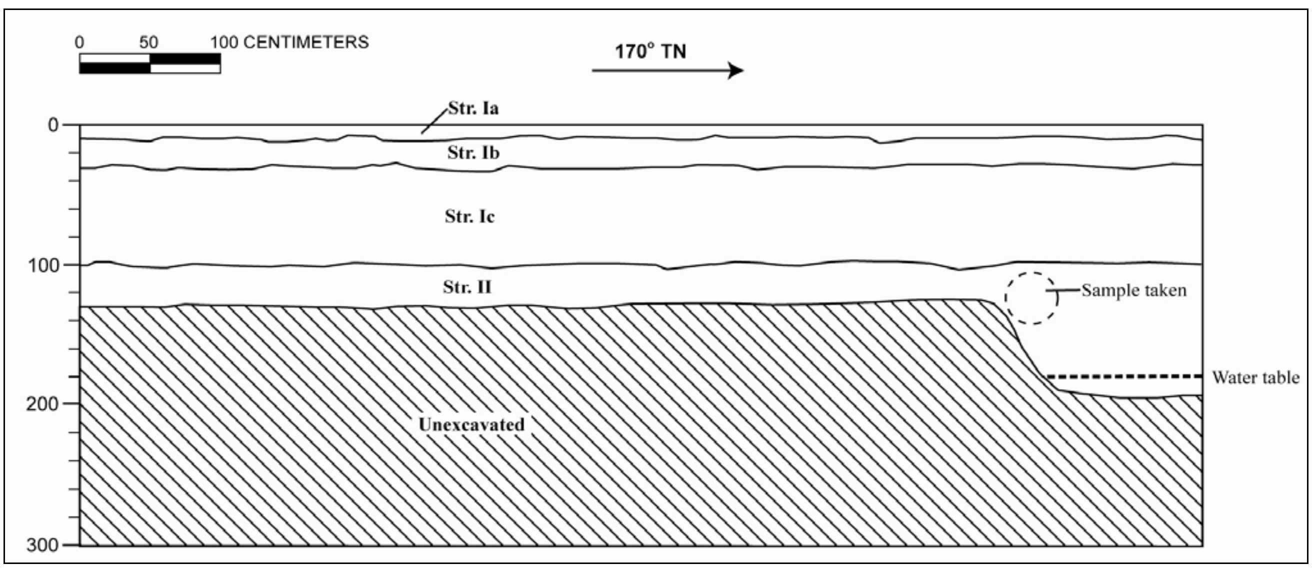

Figure 204. Profile of Waipahu Transit Center Station Makai Trench 1

Figure 205. Photograph of Waipahu Transit Center Station Makai Trench 1, view to east

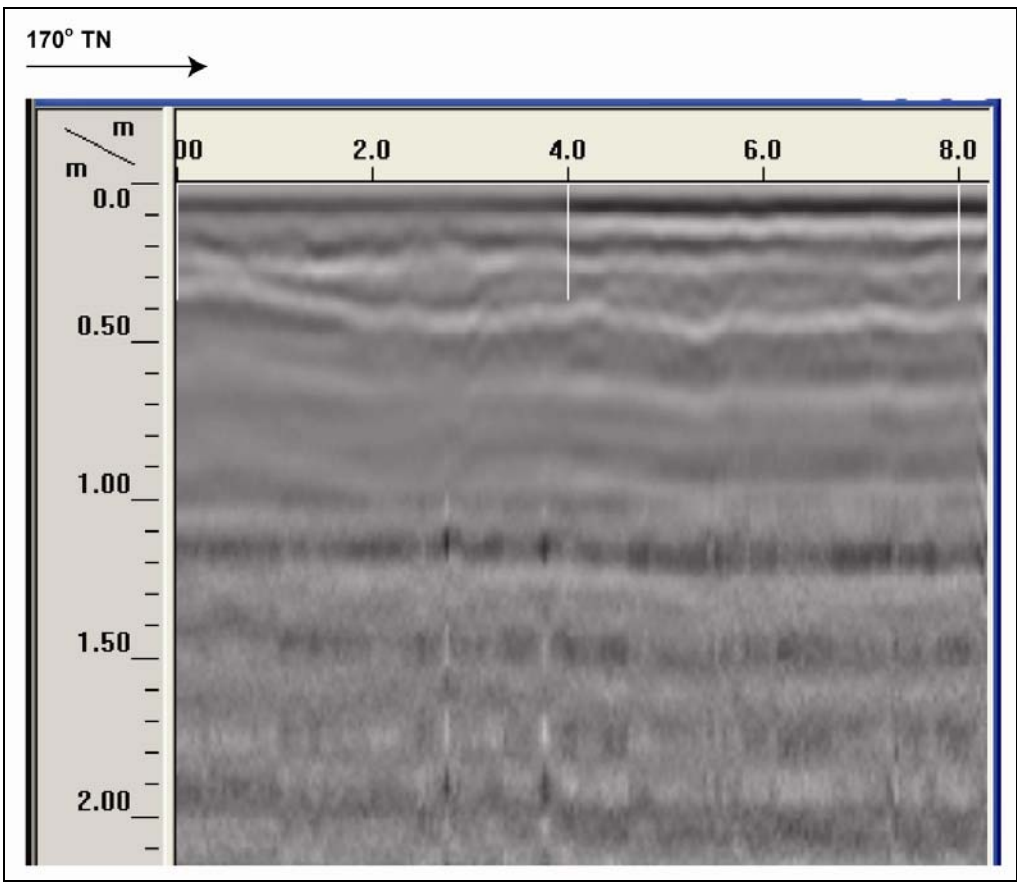

Figure 206. GPR profile of Waipahu Transit Center Station Makai Trench 1

Waipahu Transit Center Station Makai Trench 2

Orientation	170° TN
Length	4 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Crushed coral fill
Ic	20-50	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	50-125	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	125-200	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

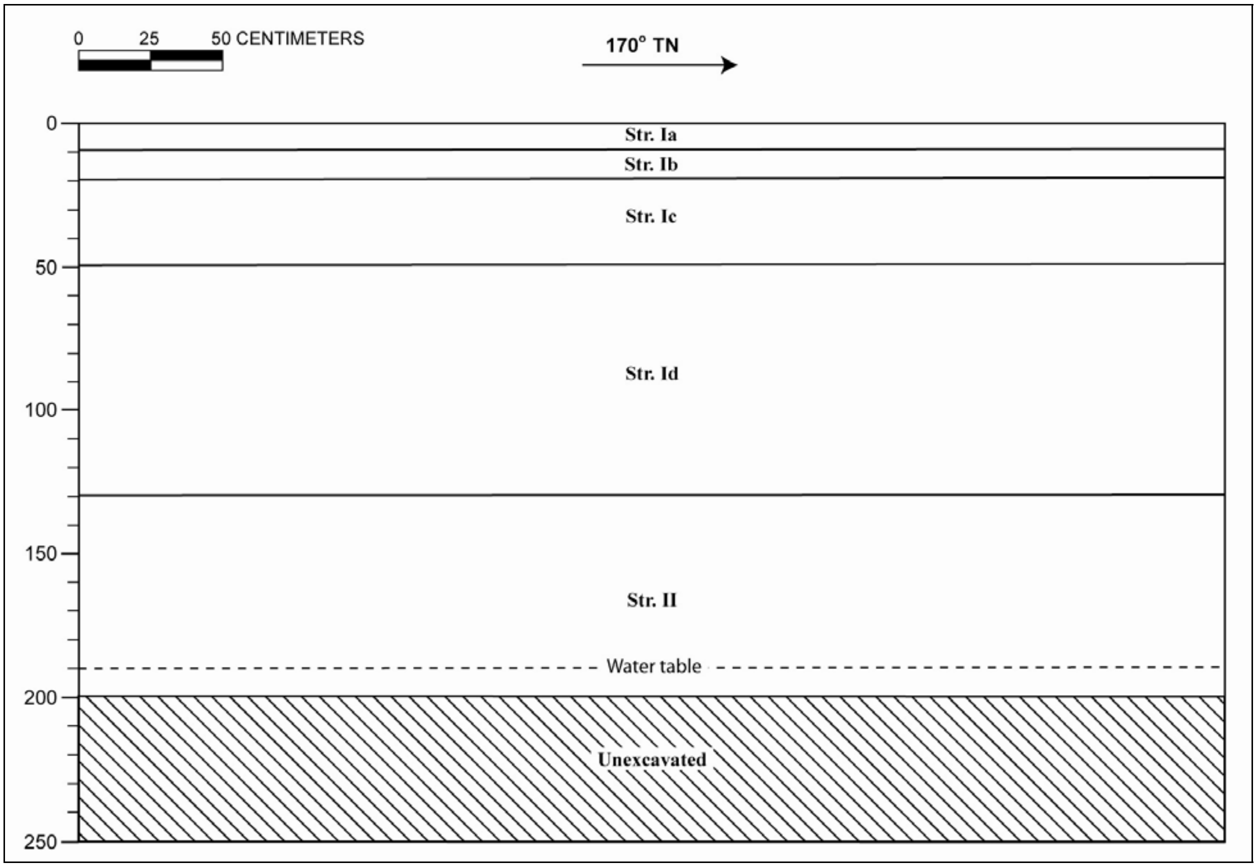

Figure 207. Waipahu Transit Center Station Makai Trench 2

Figure 208. Photograph of Waipahu Transit Center Station Makai Trench 2, view to east

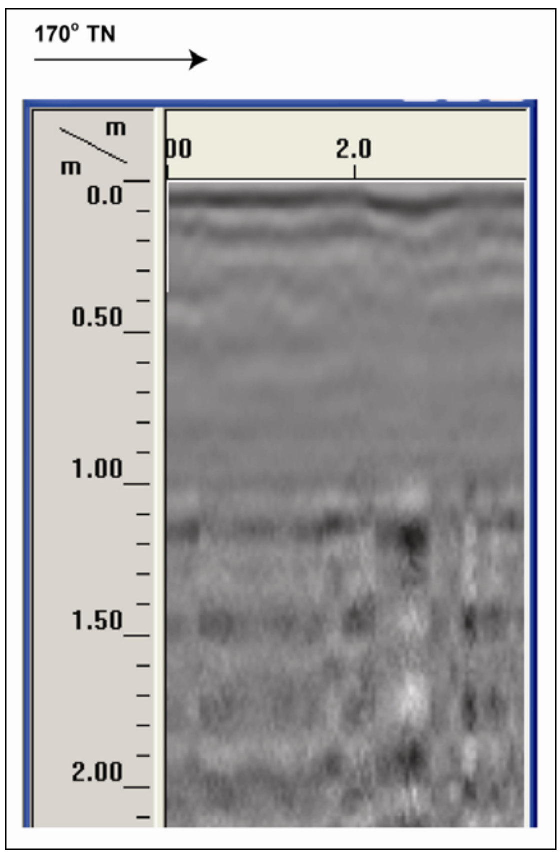

Figure 209. GPR profile of Waipahu Transit Center Station Makai Trench 2

Waipahu Transit Center Station Makai Trench 3

Orientation	170° TN
Length	4 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Crushed coral fill
Ic	20-60	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	60-130	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	130-200	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

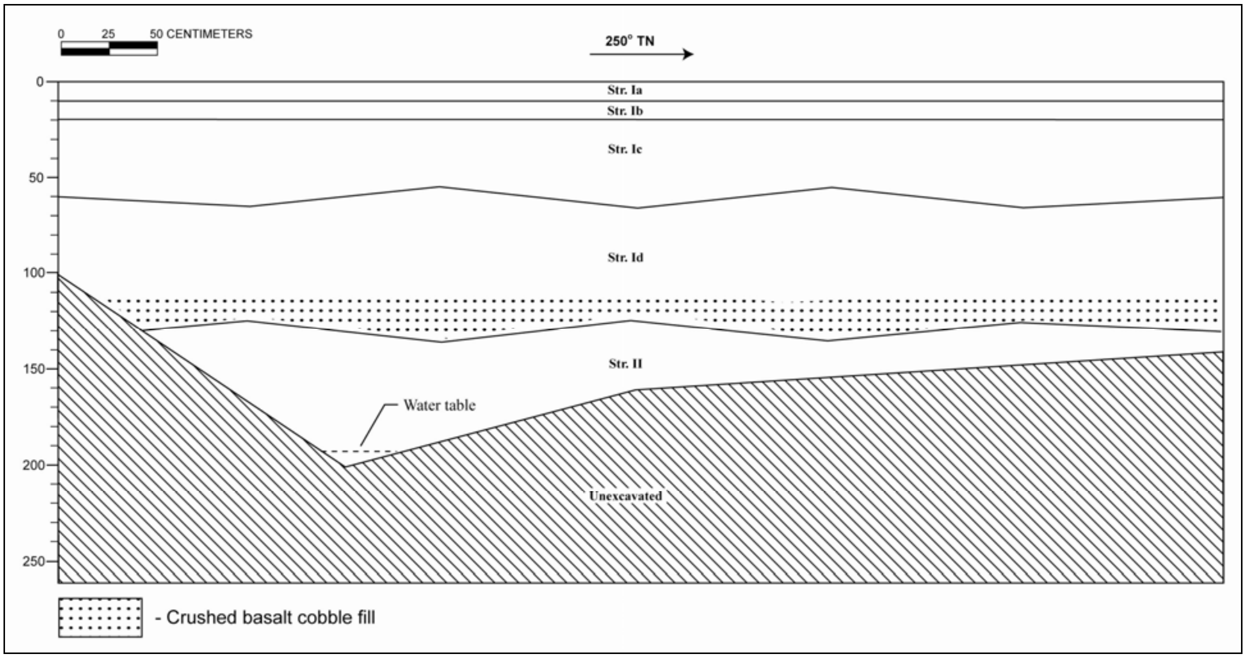

Figure 210. Profile of Waipahu Transit Center Station Makai Trench 3

Figure 211. Photograph of Waipahu Transit Center Station Makai Trench 3, view to south

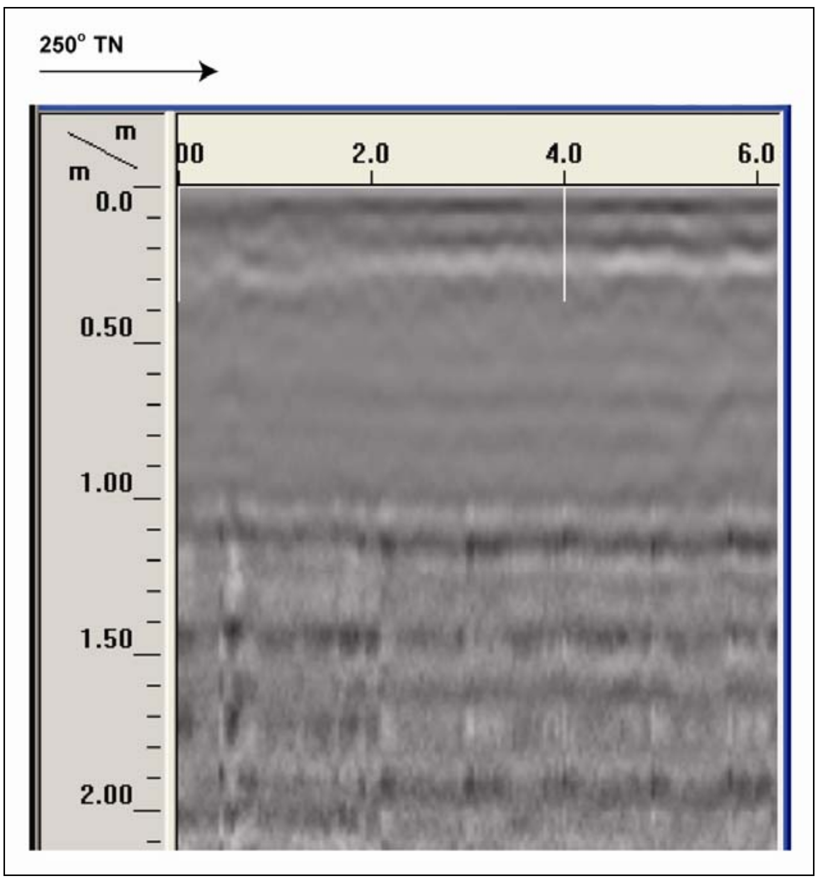

Figure 212. GPR profile of Waipahu Transit Center Station Makai Trench 3

Waipahu Transit Center Station Makai Trench 4

Orientation	250° TN
Length	3 m
Width	0.8 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
Ia	0-5	Asphalt
Ib	5-20	Crushed coral fill
Ic	20-75	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	75-130	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	130-175	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

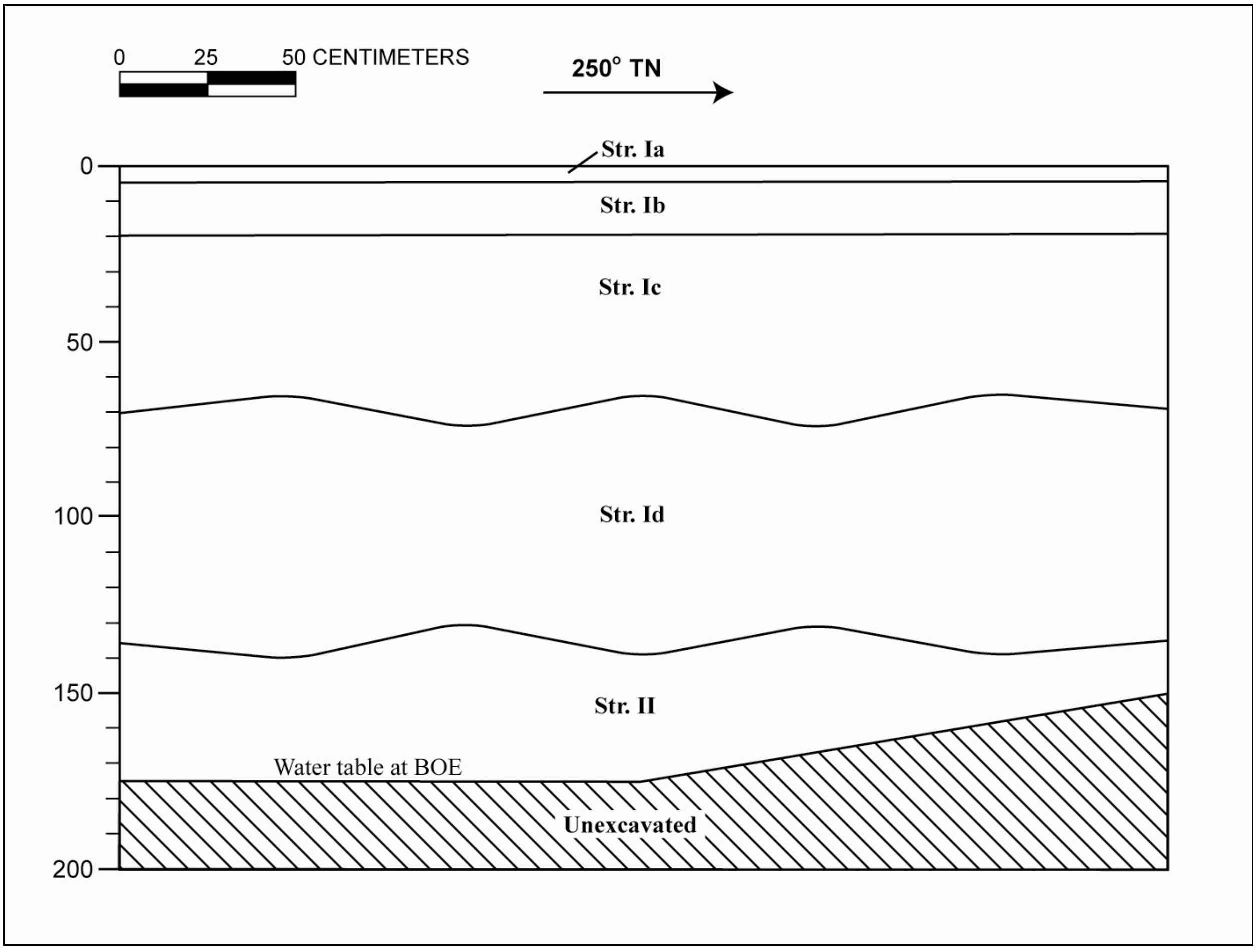

Figure 213. Profile of Waipahu Transit Center Station Makai Trench 4

Figure 214. Photograph of Waipahu Transit Center Station Makai Trench 4, view to south

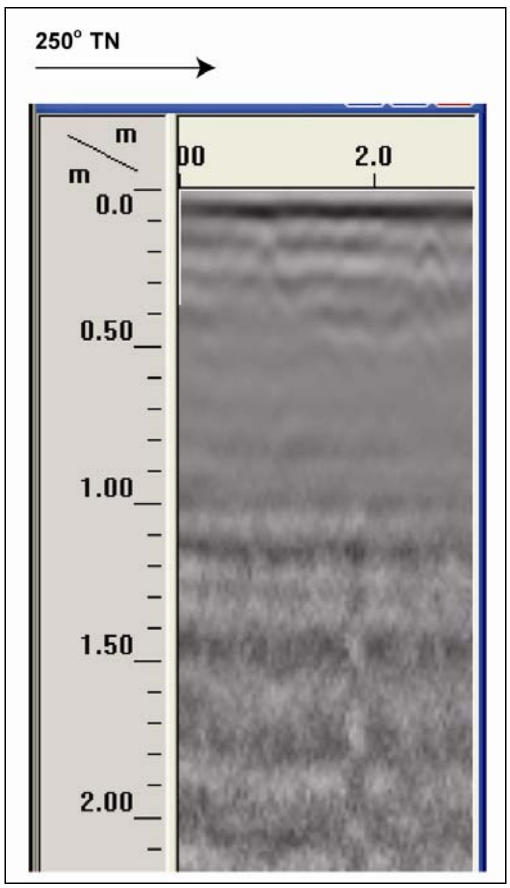

Figure 215. GPR profile of Waipahu Transit Center Station Makai Trench 4

Waipahu Transit Center Station Makai Trench 5

Orientation	256° TN
Length	4.5 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-50	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Ic	50-110	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	110-210	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

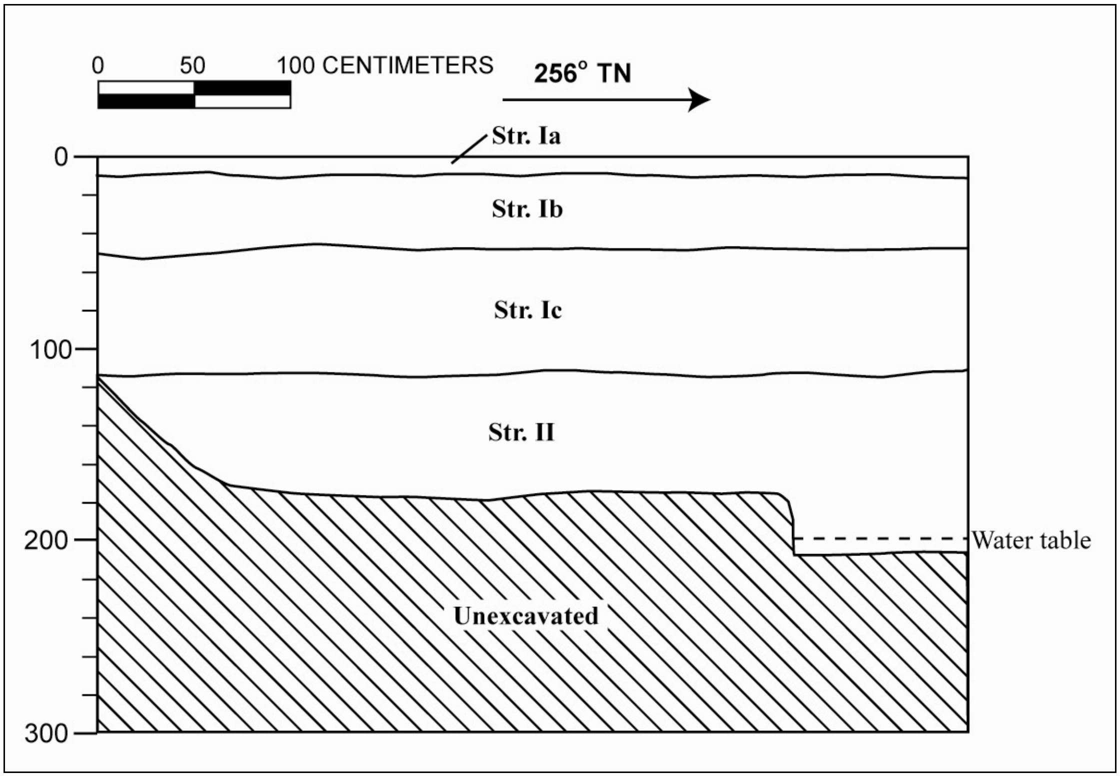

Figure 216. Profile of Waipahu Transit Center Station Makai Trench 5

Figure 217. Photograph of Waipahu Transit Center Station Makai Trench 5, view to south

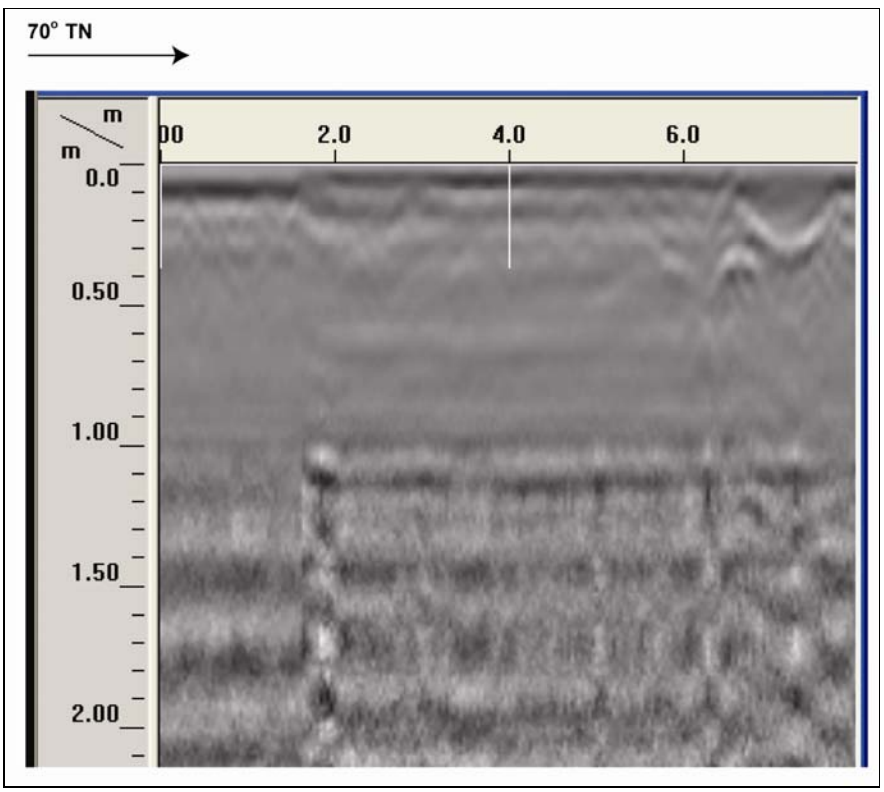

Figure 218. GPR profile of Waipahu Transit Center Station Makai Trench 5

Waipahu Transit Center Station Makai Trench 6

Orientation	70° TN
Length	8 m
Width	0.8 m
Maximum Depth	2.3 m

Stratum	Depth (cmbs)	Description
Ia	0-5	Asphalt
Ib	5-20	Crushed coral fill
Ic	20-50	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	50-120	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	120-230	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

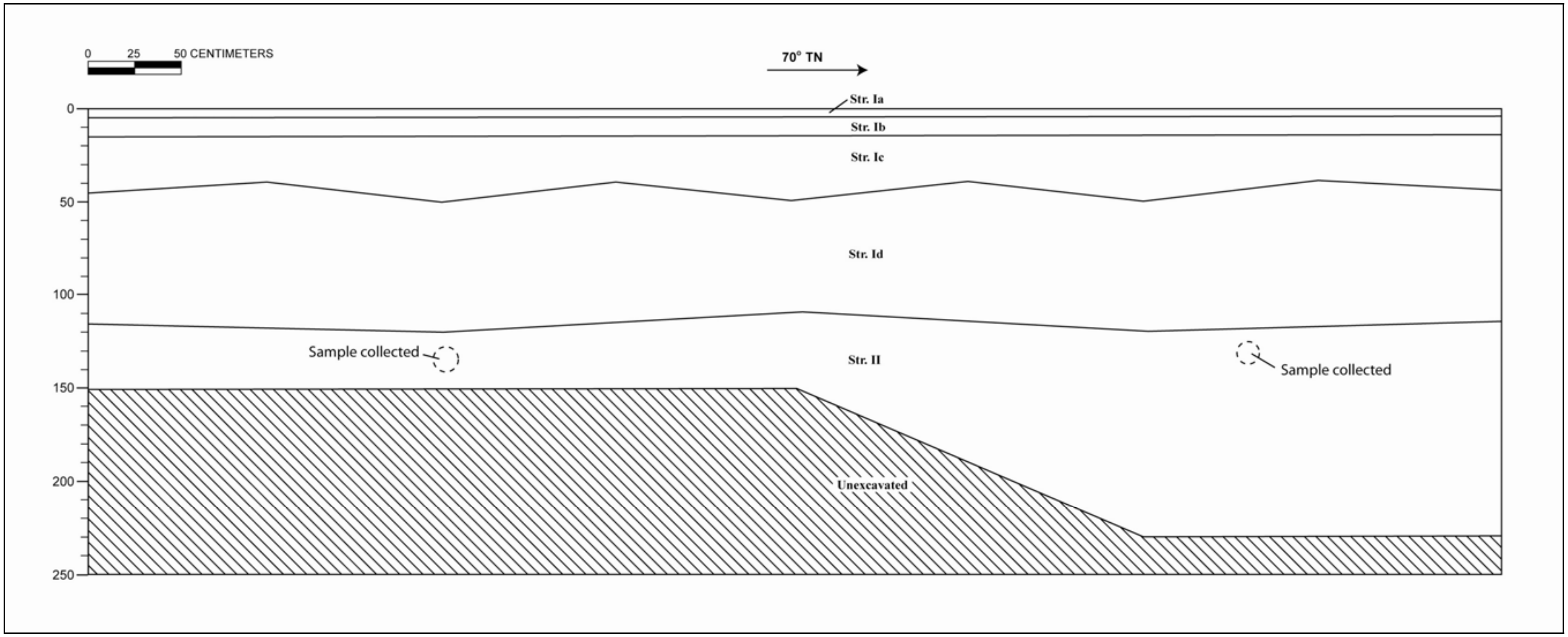

Figure 219. Profile of Waipahu Transit Center Station Makai Trench 6

Figure 220. Photograph of Waipahu Transit Center Station Makai Trench 6, view to north

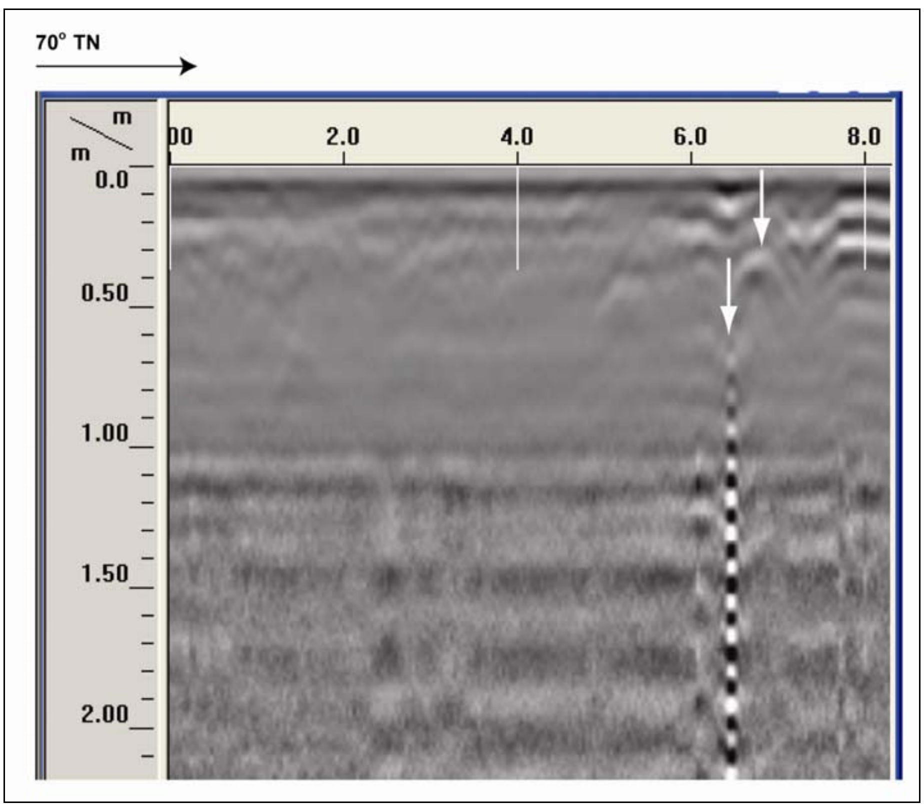

Figure 221. GPR profile of Waipahu Transit Center Station Makai Trench 6

Column Test 21 (C-21)

Orientation	079° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill; 7.5 YR 3/2, dark brown; clay loam; moderate, fine, crumb structure; very friable moist consistency; sticky wet consistency; plastic; no cementation; abrupt smooth lower boundary; topsoil for landscaped median, roots and rootlings from grass and trees
Ib	30-60	Fill; 10 YR 4/3, brown; silt loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; grading and landscaping material- 1/2" irrigation hose, pipe at 30 - 45cmbsl
Ic	60-90	Fill; 5 YR 3/2, dark reddish brown; garvelly, coral, silt; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; drainage fill-contains gravel and coral cobbles
II	90-150	7.5 YR 4/3, brown; clay loam; moderate, fine, crumb structure; firm moist consistency; sticky wet consistency; plastic; no cementation; abrupt smooth lower boundary; natural upper sediment contains small cobbles
III	150-160	10 YR 3/2, very dark grayish brown; clay; strong, fine, crumb structure; firm moist consistency; very sticky wet consistency; plastic; no cementation; Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

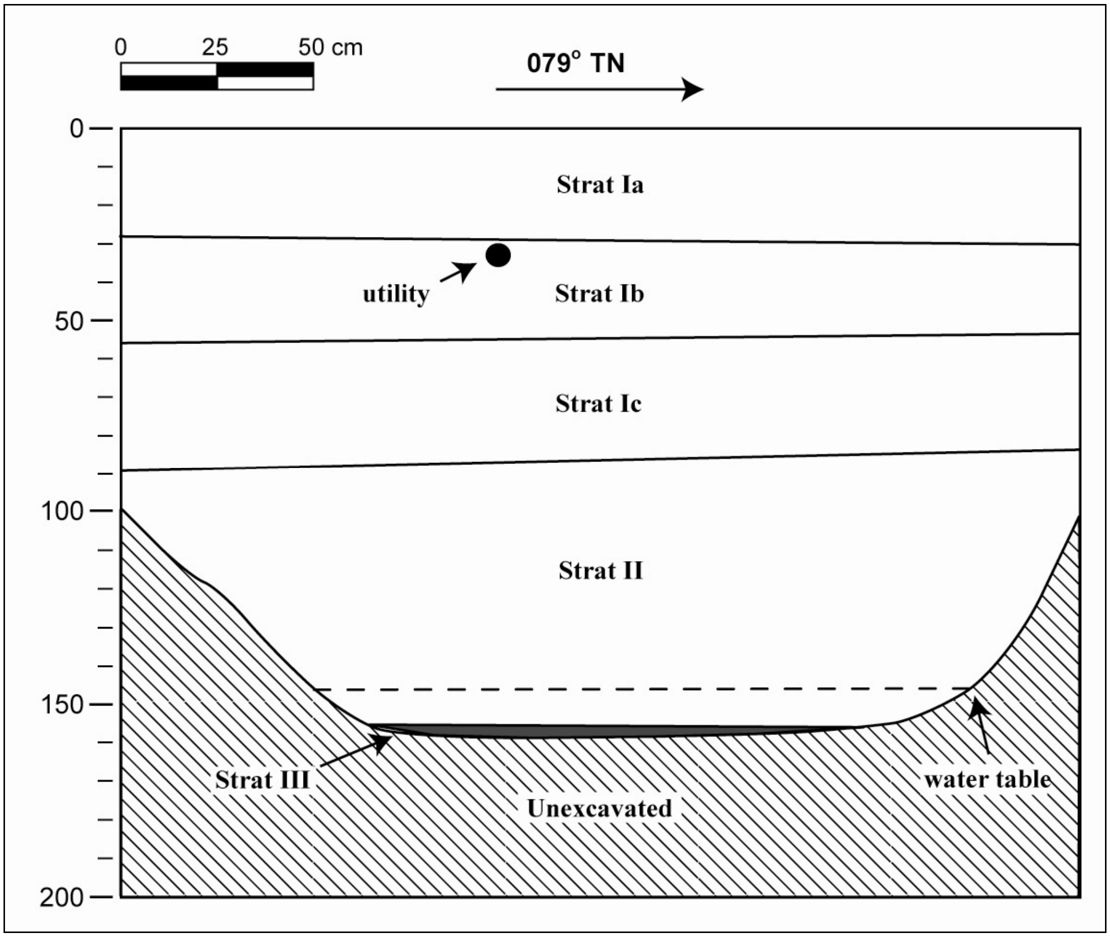

Figure 222. Profile of Column Test 21 (C-21)

Figure 223. Photograph of Column Test 21 (C-21), view to north

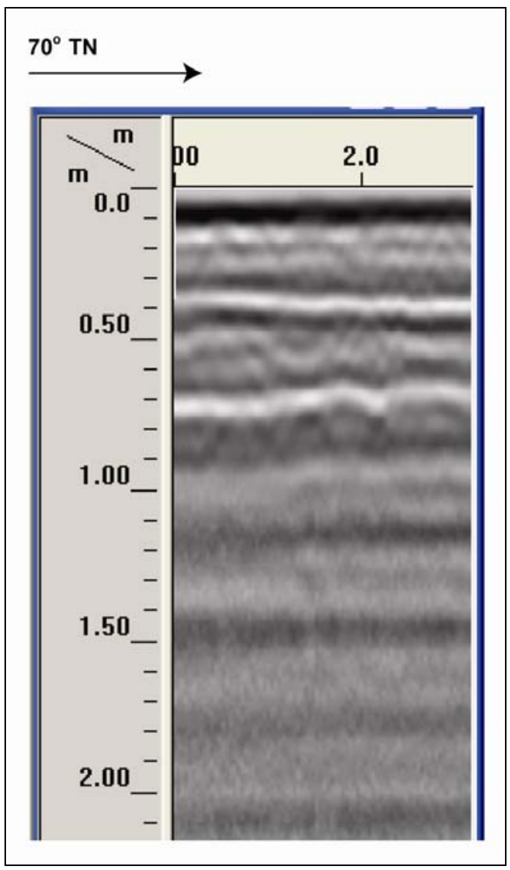

Figure 224. GPR profile of Column Test 21 (C-21)

Column Test 22 (C-22)

Orientation	258° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Asphalt
Ib	40-75	Fill Horizon; 10 YR 4/1, dark gray; garvelly, cobbly, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; gravel/sand fill underlying asphalt
II	75-150	Fill Horizon; 10 YR 3/3, dark brown; clay loam; moderate, fine, crumb structure; very firm moist consistency; very sticky wet consistency; plastic; no cementation; back-filled natural sediments, water table at BOE

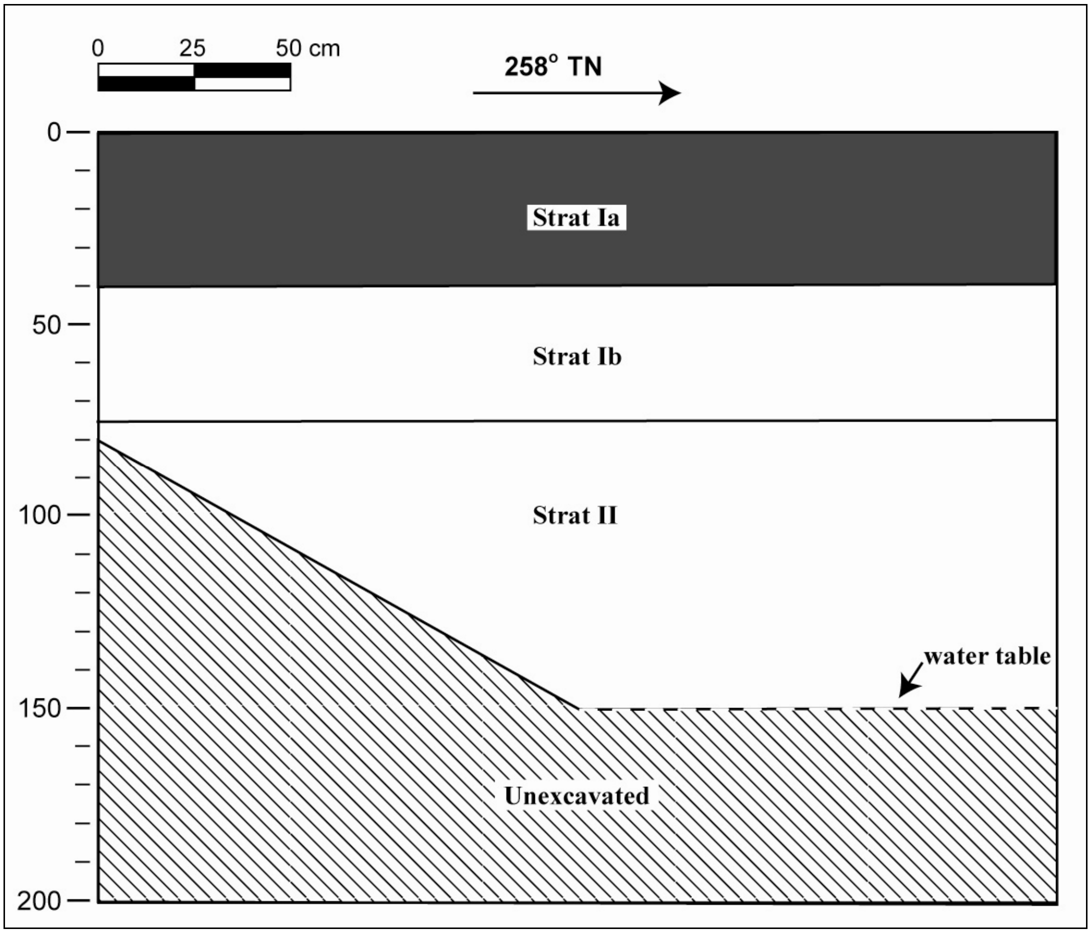

Figure 225. Profile of Column Test 22 (C-22)

Figure 226. Photograph OF Column Test 22 (C-22), view to south

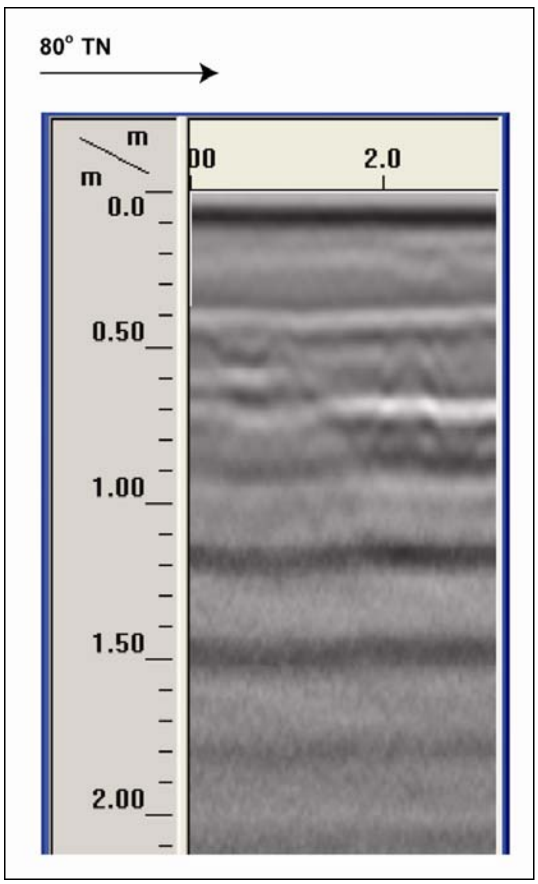

Figure 227. GPR profile of Column Test 22 (C-22)

Column Test 23 (C-23)

Orientation	258° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.9 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Asphalt
Ib	40-70	Fill Horizon; GLEY 2 3/1, very dark greenish gray; garvelly, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; gravel/sand base coarse underlying asphalt
Ic	70-160	Fill; 10 YR 3/4, dark yellowish brown; silty clay loam; moderate, medium, crumb structure; firm moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; back-filled natural sediments
II	160-190	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; very firm moist consistency; very plastic; no cementation; water table, very wet sediments, Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

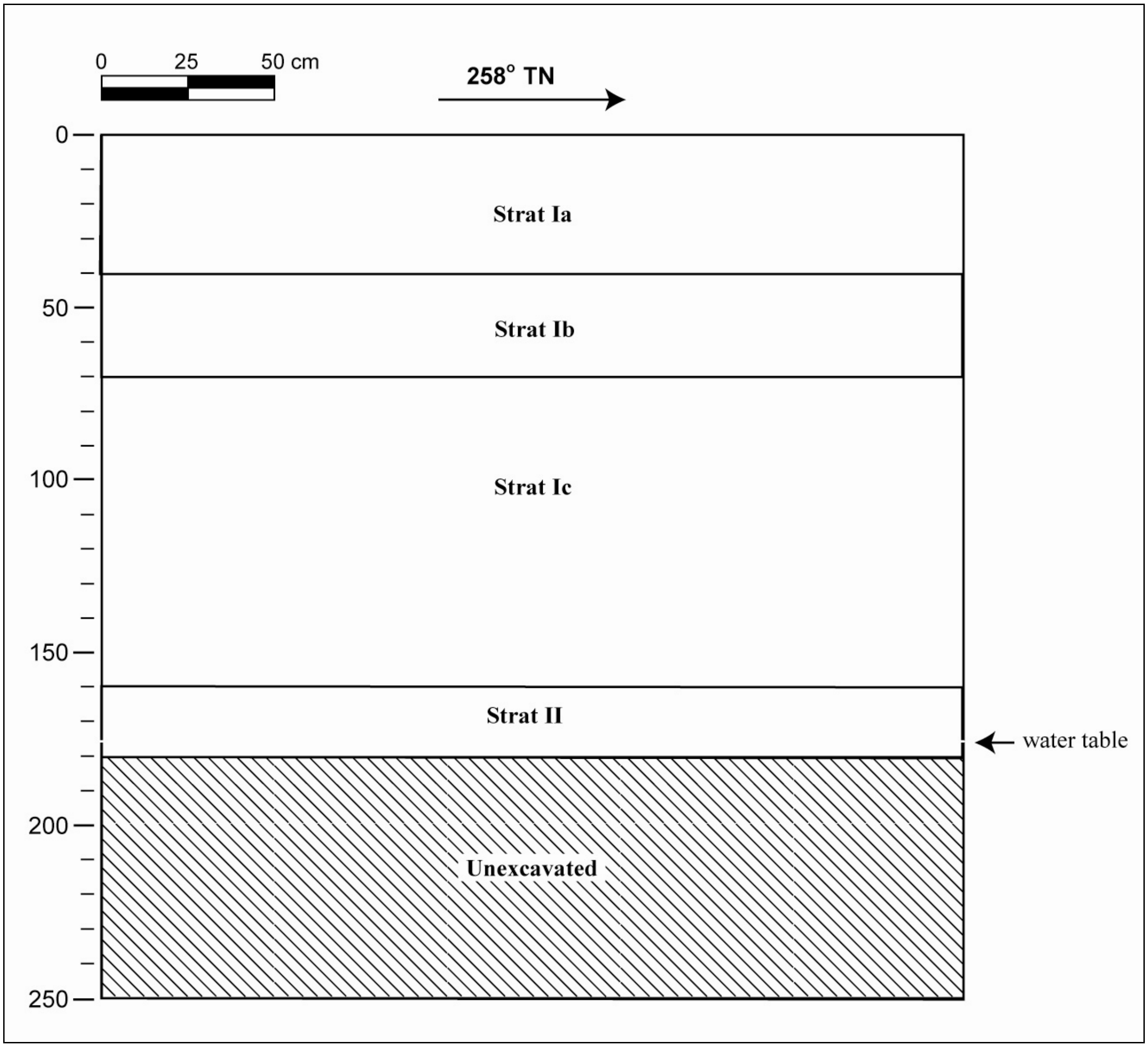

Figure 228. Profile of Column Test 23 (C-23)

Figure 229. Photograph of Column Test 23 (C-23), view to south

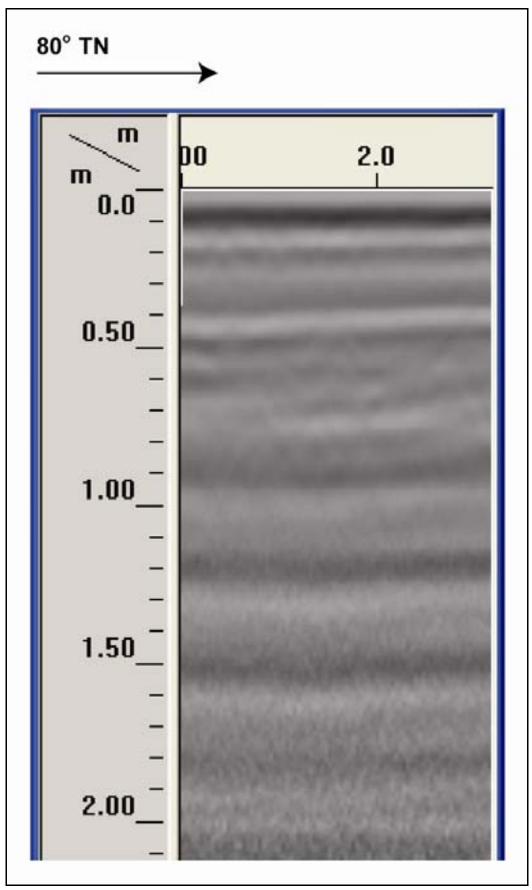

Figure 230. GPR profile of Column Test 23 (C-23)

Column Test 24 (C-24)

Orientation	151° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Asphalt
Ib	50-60	Fill; 10 YR 4/1, dark gray; garvelly, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; gravel/sand fill underlying road surface, grading material
Ic	60-170	Fill; 10 YR 3/4, dark yellowish brown; garvelly, clay loam; weak, fine, crumb structure; loose dry consistency; friable moist consistency; non-sticky wet consistency; slightly plastic; no cementation; abrupt smooth lower boundary; terrigenous fill used to cover wetlands prevent ground water from seeping up
II	170-200	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; very firm moist consistency; very plastic; no cementation; water table, very wet sediments, Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

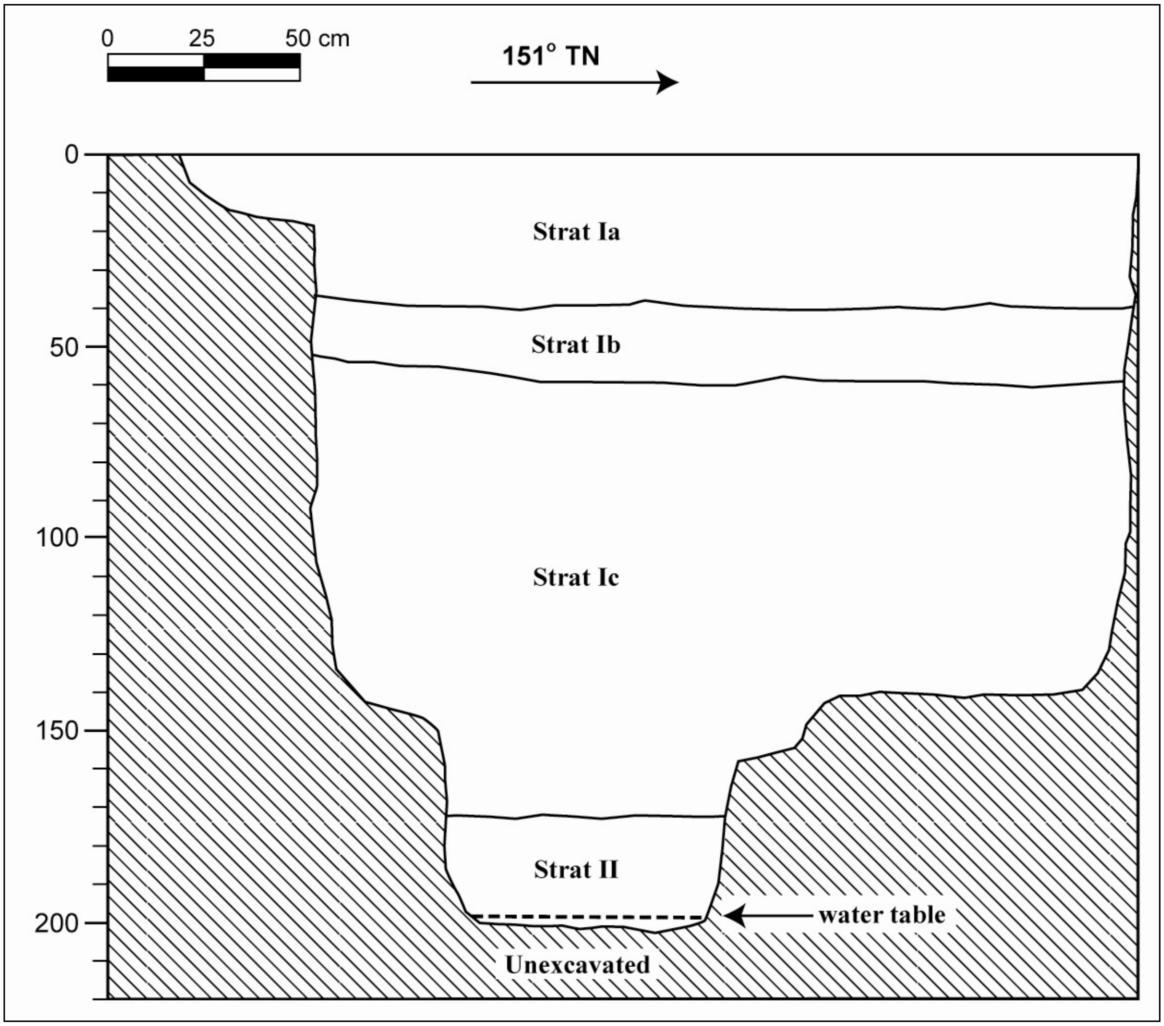

Figure 231. Profile of Column Test 24 (C-24)

Figure 232. Photograph of Column Test 24 (C-24), view to northeast

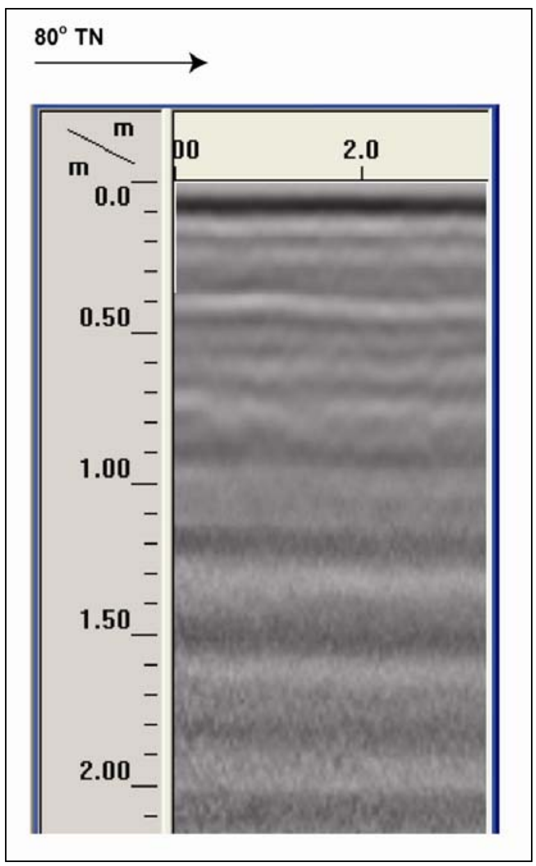

Figure 233. GPR profile of Column Test 24 (C-24)

Column Test 25 (C-25)

Orientation	76° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.4 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 5 YR 3/4, dark reddish brown; silt loam; weak, medium, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Landscaping fill for hwy median.
Ib	40-90	Fill Horizon; 10 YR 4/2, dark grayish brown; coarse, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Contains gravel; appears to be a combination of grading material and grouted coushion material for utilities.
Ic	90-110	Fill Horizon; 2.5 Y 7/3, pale yellow; coarse, sand; weak, coarse or thick, blocky structure; loose dry consistency; non-plastic; no cementation; clear smooth lower boundary; Grading material.
II	110-210	Fill Horizon; 10 YR 3/4, dark yellowish brown; silty clay; moderate, fine, crumb structure; hard dry consistency; very firm moist consistency; plastic; no cementation; diffuse irregular lower boundary; Back-filled possibly by natural sediments used as grading material, possibly mixed w/ clay layer below.
III	140-240	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; extremely firm moist consistency; very plastic; no cementation; Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

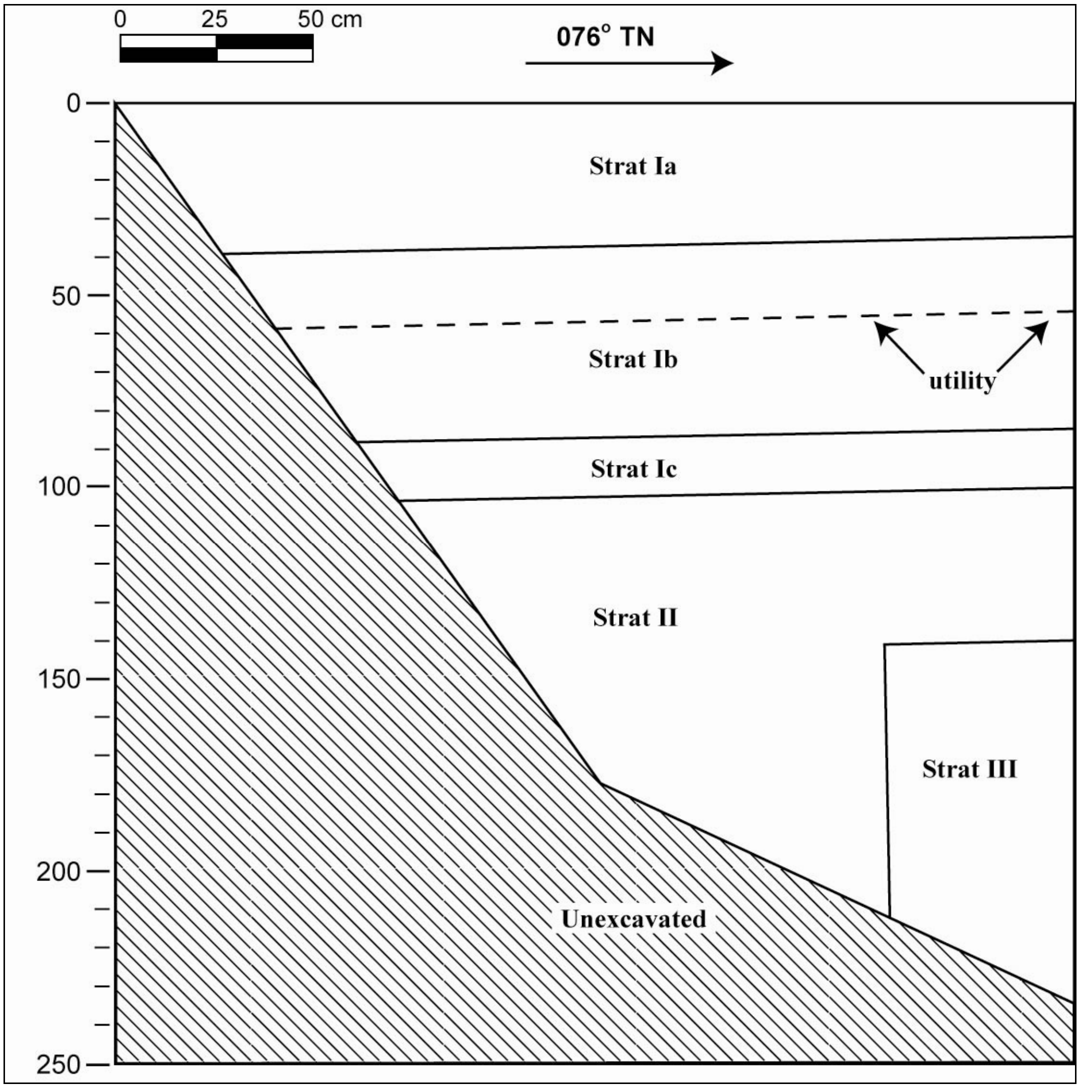

Figure 234. Profile of Column Test 25 (C-25)

Figure 235. Photograph of Column Test 25 (C-25), view to north

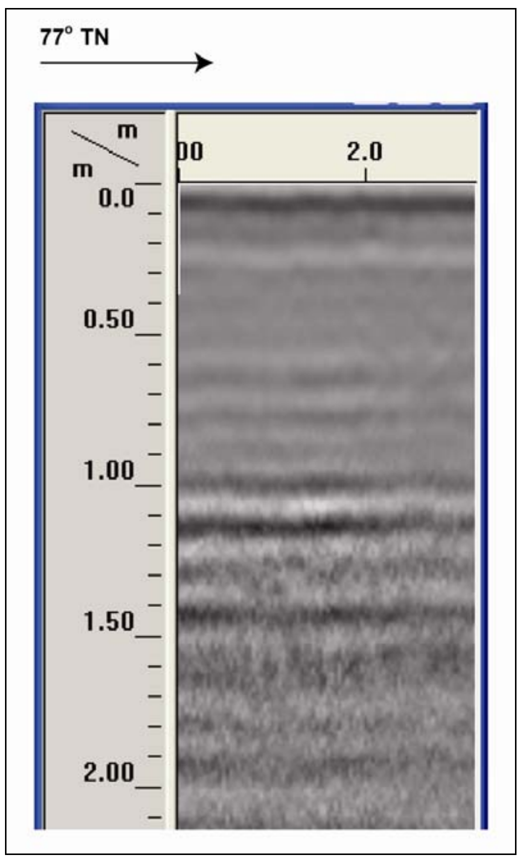

Figure 236. GPR profile of Column Test 25 (C-25)

Column Test 26 (C-26)

Orientation	268° TN
Length	2 m
Width	2 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Fill; 5 YR 3/3, dark reddish brown; silty clay loam; moderate, fine, crumb structure; very friable moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Topsoil for landscaping of median.
Ib	10-30	Fill; 7.5 YR 3/4, dark brown; clay loam; weak, fine, crumb structure; loose dry consistency; very friable moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; Grading/landscaping (fill) material.
Ic	30-90	Fill; 10 YR 5/1, gray; gravel; structureless, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill.
Id	90-100	Fill; 10 YR 8/2, very pale brown; very coarse, sand; structureless, loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Contains crushed coral.
Ie	100-240	Fill; 7.5 YR 2.5/3, very dark brown; silt loam; moderate, fine, crumb structure; loose dry consistency; loose moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Terrigenous fill overlying natural wetland sediments.
II	240-260	GLEY 2 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; firm moist consistency; sticky wet consistency; plastic; no cementation. Natural wetland sediments w/ some biological (root) matter.

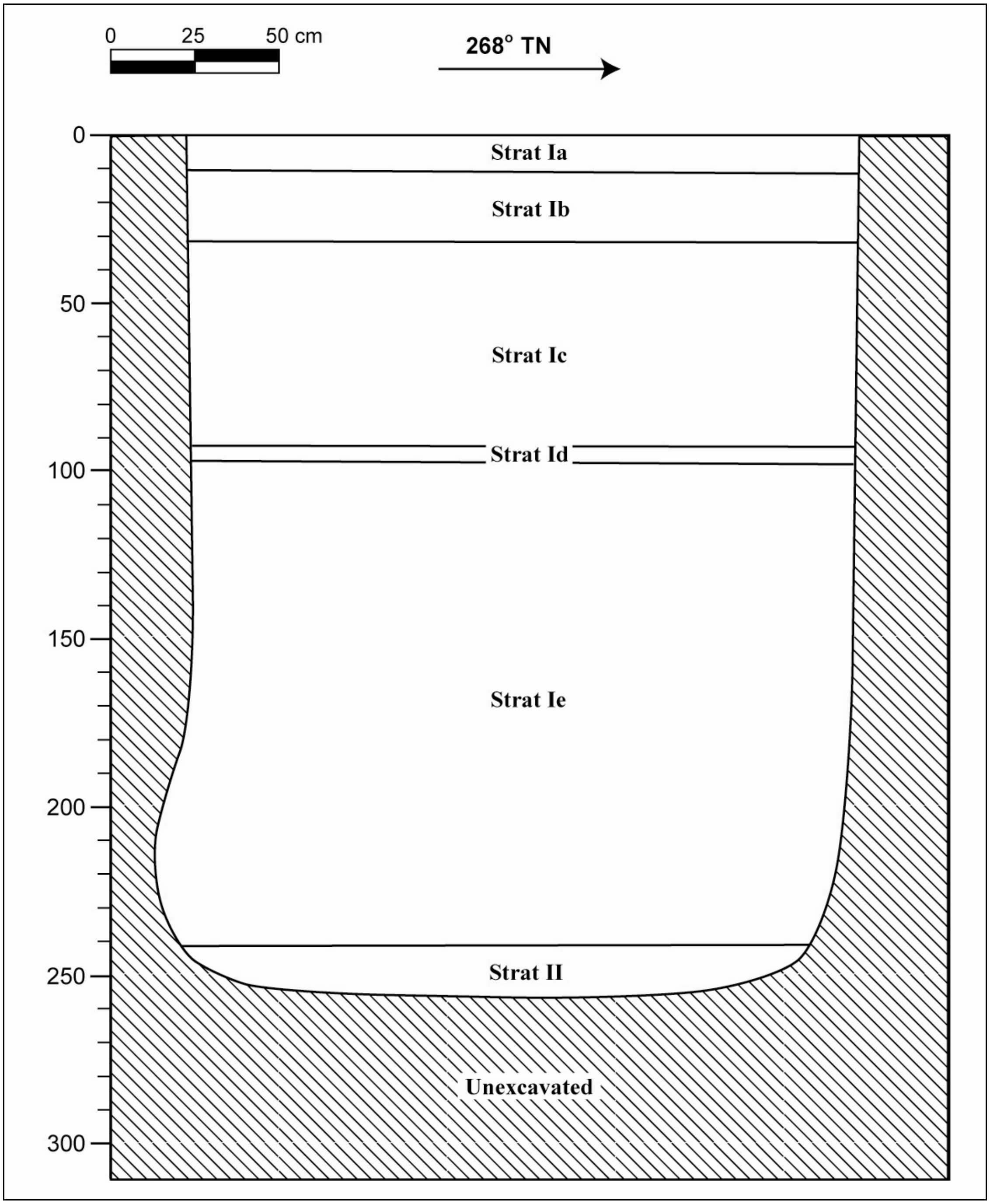

Figure 237. Profile of Column Test 26 (C-26)

Figure 238. Photograph of Column Test 26 (C-26), view to south

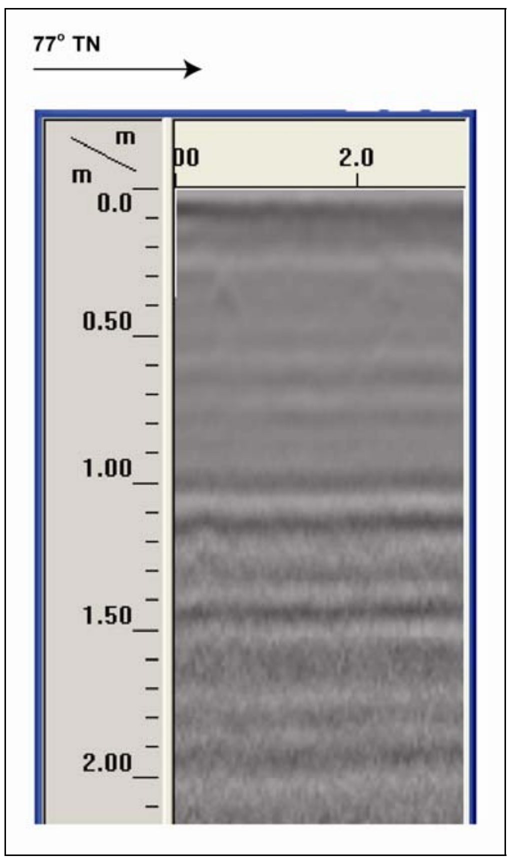

Figure 239. GPR profile of Column Test 26 (C-26)

Column Test 27 (C-27)

Orientation	347° TN
Length	1.5 m
Width	1.5 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill; 2.5 YR 3/4, dark reddish brown; silt loam; structureless, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Landscaping fill
Ib	25-35	Fill; 10 YR 3/4, dark yellowish brown; silt loam; structureless, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; 2nd strata of landscaping fill
Ic	35-125	Fill; 10 YR 4/2, dark grayish brown; gravel, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; grading material
Id	125-240	Fill; 10 YR 3/3, dark brown; silty clay loam; weak, medium, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; clear possibly back-filled natural sediments, maybe grading material
II	240-260	GLEY 2 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; firm moist consistency; sticky wet consistency; plastic; no cementation. Natural wetland sediments w/ some biological (root) matter.

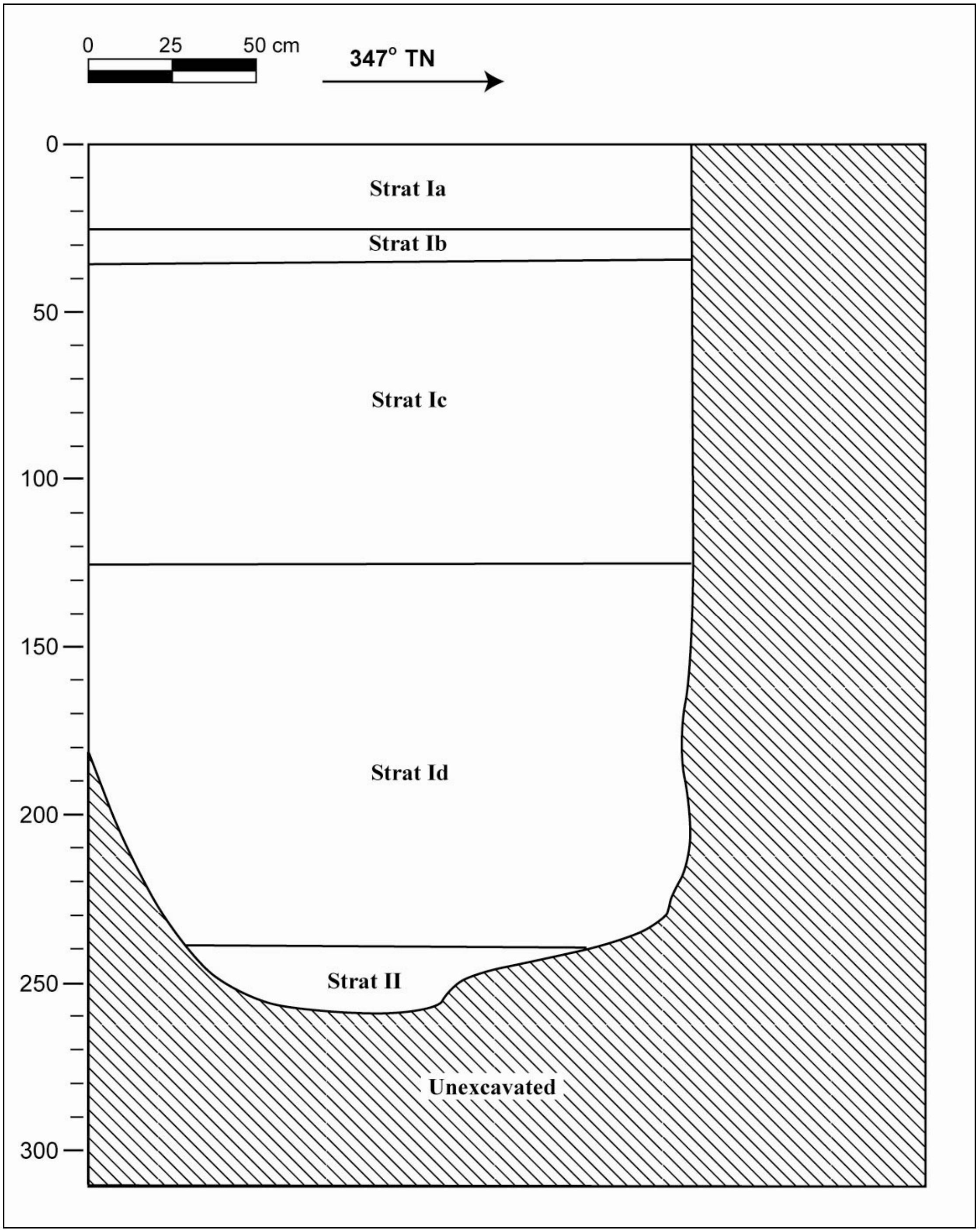

Figure 240. Profile of Column Test 27 (C-27)

Figure 241. Profile of Column Test 27 (C-27)

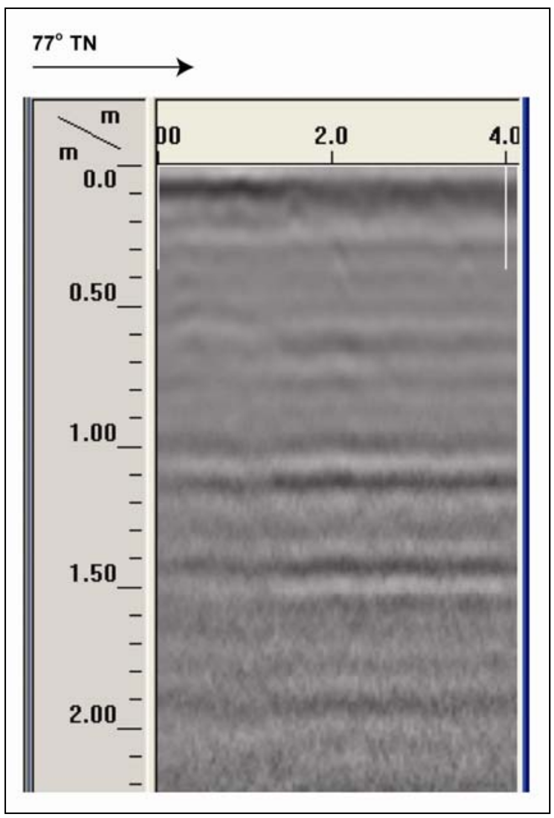

Figure 242. GPR profile of Column Test 27 (C-27)

4.12 Construction Sheet RW012

Construction Sheet RW012 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor (Figure 243). Two column test pits (C-28 & C-29) were excavated within the area delineated by Construction Sheet RW012.

4.12.1 Pedestrian Inspection

The highly urbanized conditions of Waipahu continue to predominate the area along this segment of the proposed transit route. Though not as bustling with small stores and industrial businesses as previously seen, there is a high amount of various types of housing on both sides of Farrington Highway (Figure 244). The *mauka*/northern-northwestern side is mostly low-rise apartments and condominiums while the *makai* /south-southeastern side is a family housing subdivision. Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.12.2 GPR Survey

Prior to the excavation of column test pits, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. Stratigraphic interfaces of sediments with varying consistencies (i.e. crushed coral and sand vs. clay sediments) were not identified by the GPR (see Figure 245 thru Figure 249). It is believed that the presence of thick clay deposits in this area was the primary factor to the inconsistent results of the GPR data. Clay soils (especially those that are inundated) are noted as being very conductive, resulting in radio wave attenuation at shallow depths causing limited depth “visibility” and inaccurate GPR data collection (Conyers 2004).

4.12.3 Subsurface Testing

4.12.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW012 (see Figure 243). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 245 to Figure 249).

In general the observed and documented stratigraphy consisted of varying imported construction fill layers overlying naturally deposited alluvial sediment. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

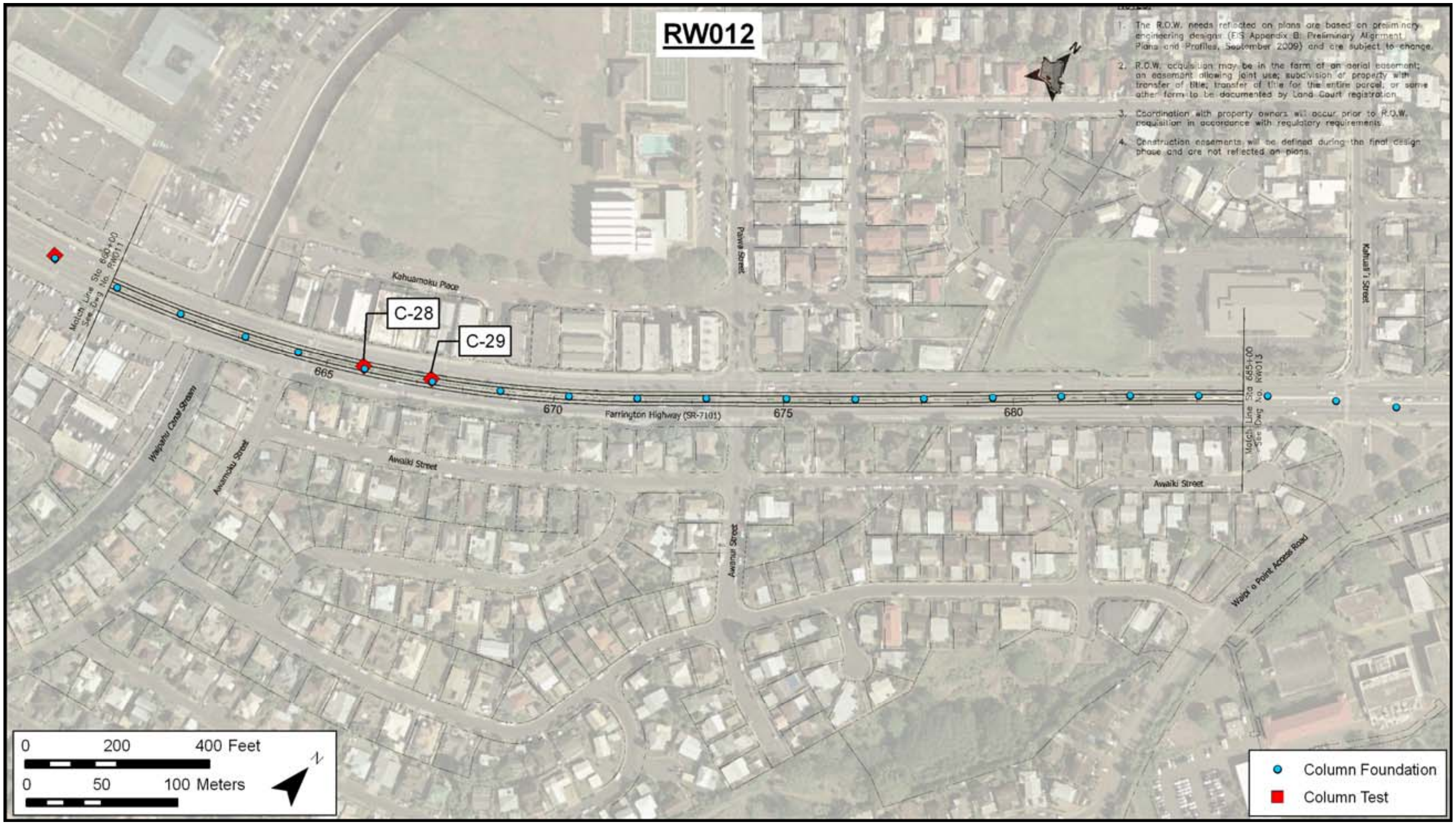

Figure 243. Construction Sheet RW012 showing the location of test excavations

Figure 244. Photo showing various housing types built alongside Farrington Highway and the transit route within the segment covered by map RW012

4.12.3.2 Excavation Documentation

Column Test 28 (C-28)

Orientation	244° TN
Length	1.5 m
Width	1.5 m
Maximum Depth	1.8 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill; 10 YR 3/2, very dark grayish brown; silty clay loam; weak, fine, crumb structure; loose dry consistency; very friable moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; Topsoil for landscaping of highway median.
Ib	30-60	Fill; 7.5 YR 3/3, dark brown; silt loam; weak, fine, crumb structure; loose dry consistency; very friable moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill for highway.
Ic	60-70	Fill; 10 YR 8/1, white; very coarse, sand; structureless, loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Contains coral; grading/drainage material.
II	70-180	10 YR 4/3, brown; clay loam; moderate, fine, crumb structure; firm moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary. Naturally deposited sediment.

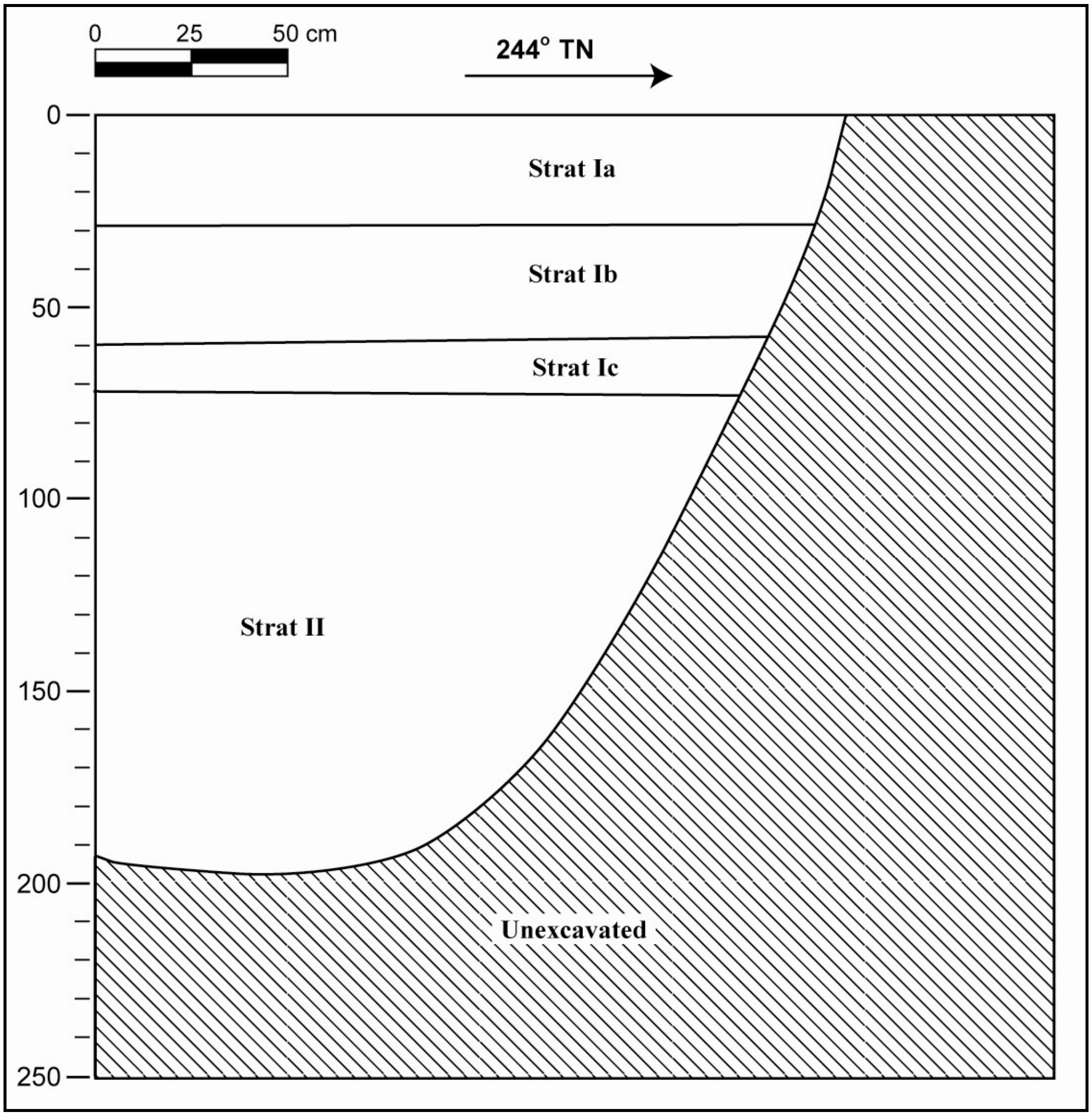

Figure 245. Profile of Column Test 28 (C-28)

Figure 246. Photograph of Column Test 28 (C-28), view to southeast

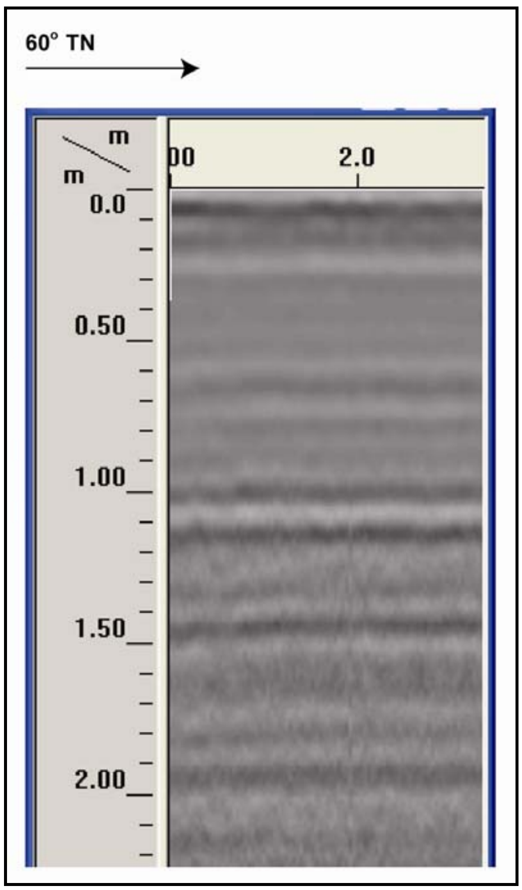

Figure 247. GPR profile of Column Test 28 (C-28)

Column Test 29 (C-29)

Orientation	260° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Fill; 10 YR 3/2, very dark grayish brown; clay loam; moderate, fine, crumb structure; extremely firm moist consistency; very sticky wet consistency; very plastic; no cementation; clear wavy lower boundary; Landscaping fill.
Ib	20-60	Fill; 10 YR 7/6, yellow; coarse, very gravelly sand; structureless, loose moist consistency; slightly plastic; no cementation; diffuse wavy lower boundary; Grading material.
II	30-210	Fill; 10 YR 3/4, dark yellowish brown; silty clay; weak, fine, crumb structure; very firm moist consistency; plastic; no cementation; diffuse irregular lower boundary; Grading material, possibly back-filled natural sediments.
III	170-210	A Horizon; 10 YR 3/1, very dark gray; clay; moderate, fine, crumb structure; very sticky wet consistency; very plastic; no cementation; Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

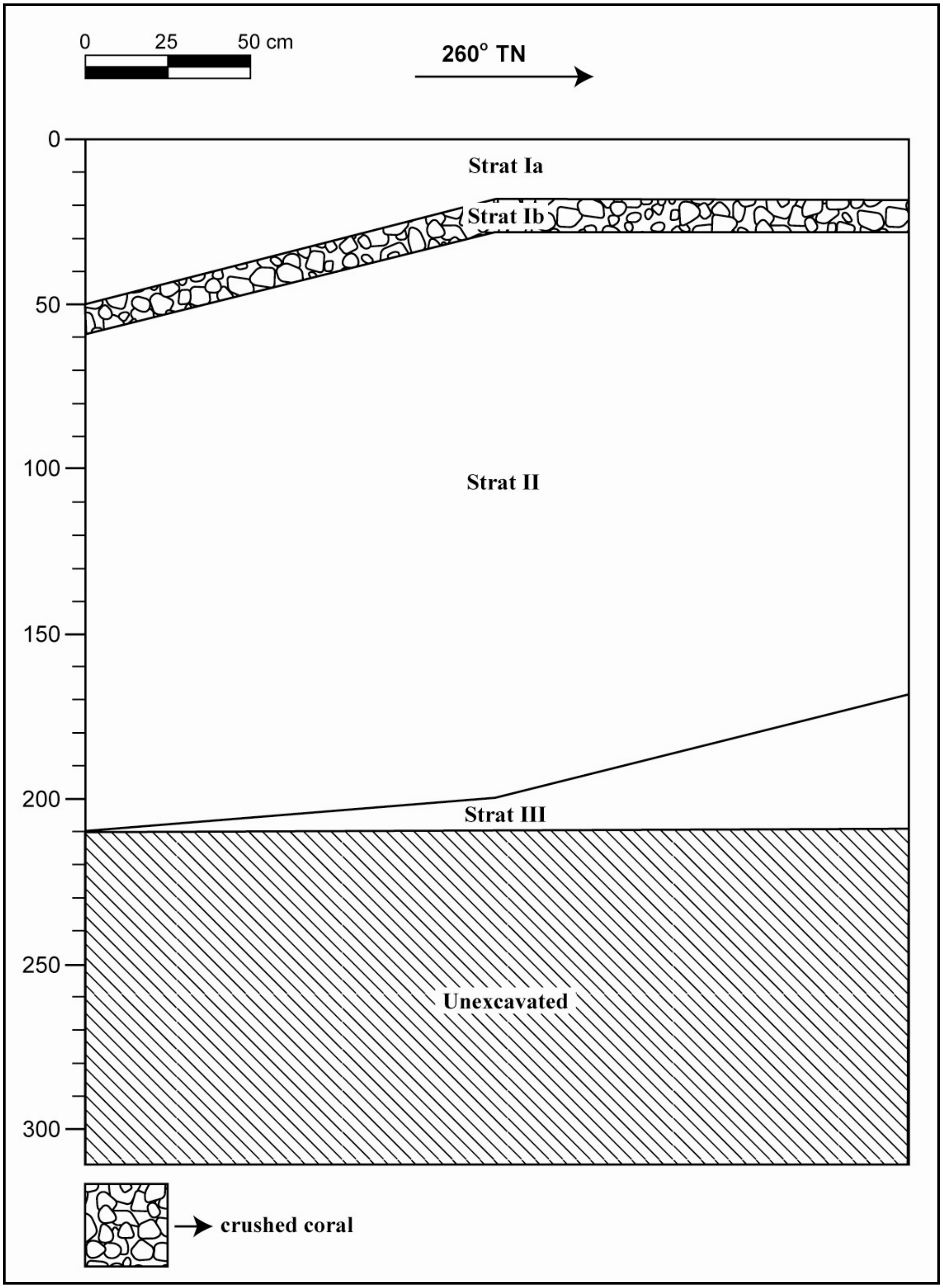

Figure 248. Profile of Column Test 29 (C-29)

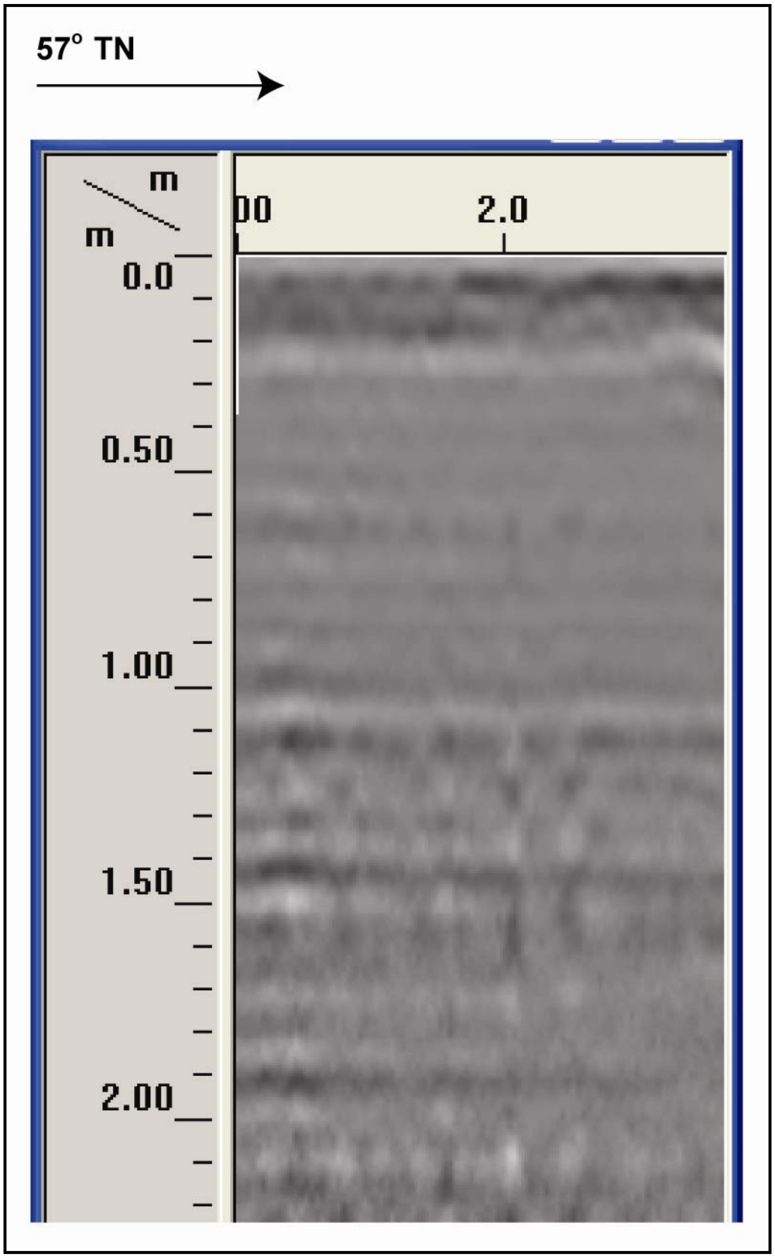

Figure 249. GPR profile of Column Test 29 (C-29)

4.13 Construction Sheet RW013 & RW014

Construction Sheet RW013 and RW014 consist of a 5,000 ft (1.5 km) segment of the proposed transit corridor (Figure 250 & Figure 251), and include the proposed Maintenance and Storage Facility and the Leeward Community College Station. Nine test trenches were excavated at the Maintenance and Storage Facility (Figure 252) and three test trenches were excavated at the Leeward Community College Station (Figure 253), totaling 12 test trenches within construction sheets RW013 and RW014.

4.13.1 Pedestrian Inspection

As the proposed transit route departs the Waipahu area and enters the Pearl City region, it transects the Waiawa area (crossing through the Navy ‘Ewa Drum Filling and Storage Area and Leeward Community College).The eastern edge of Waipahu continued to display a high amount of urbanization with housing along both sides of the proposed transit route, with Waipahu High School located *makai*/south of the route prior to it curving east into the Navy ‘Ewa Drum Filling and Storage Area.

The proposed site for the Leeward Community College Station is situated on the western end of the campus and is currently occupied by two administrative offices, a parking area, and the motorcycle safety course (Figure 254 & Figure 255). The entire area has been graded and paved over. No archaeological sites or material were identified during the pedestrian survey of this portion of the transit route due to the extensive amount of construction.

The Navy ‘Ewa Drum Filling and Storage Area, which houses the footprint of the proposed HHCTC Maintenance and Storage Facility was not subject to a pedestrian inspection, as the entire area was previously surveyed (systematic pedestrian inspection of the gound surface) by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in 1998 (Rechtman and Henry 1998). No cultural resources were observed. The PHRI study was incorporated into an environmental assessment for the Navy ‘Ewa Drum Filling and Storage Area, which provided an effect determination of “no historic properties affected” (Commander, Navy Region Hawaii 2005). SHPD was provided an opportunity to comment on the results of the environmental assessment in compliance with Section 106 of the National Historic Preservation Act. SHPD did not object to the environmental assessment’s determination of “no historic properties affected” (Commander, Navy Region Hawaii 2005).

Urban development and historic military operations within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

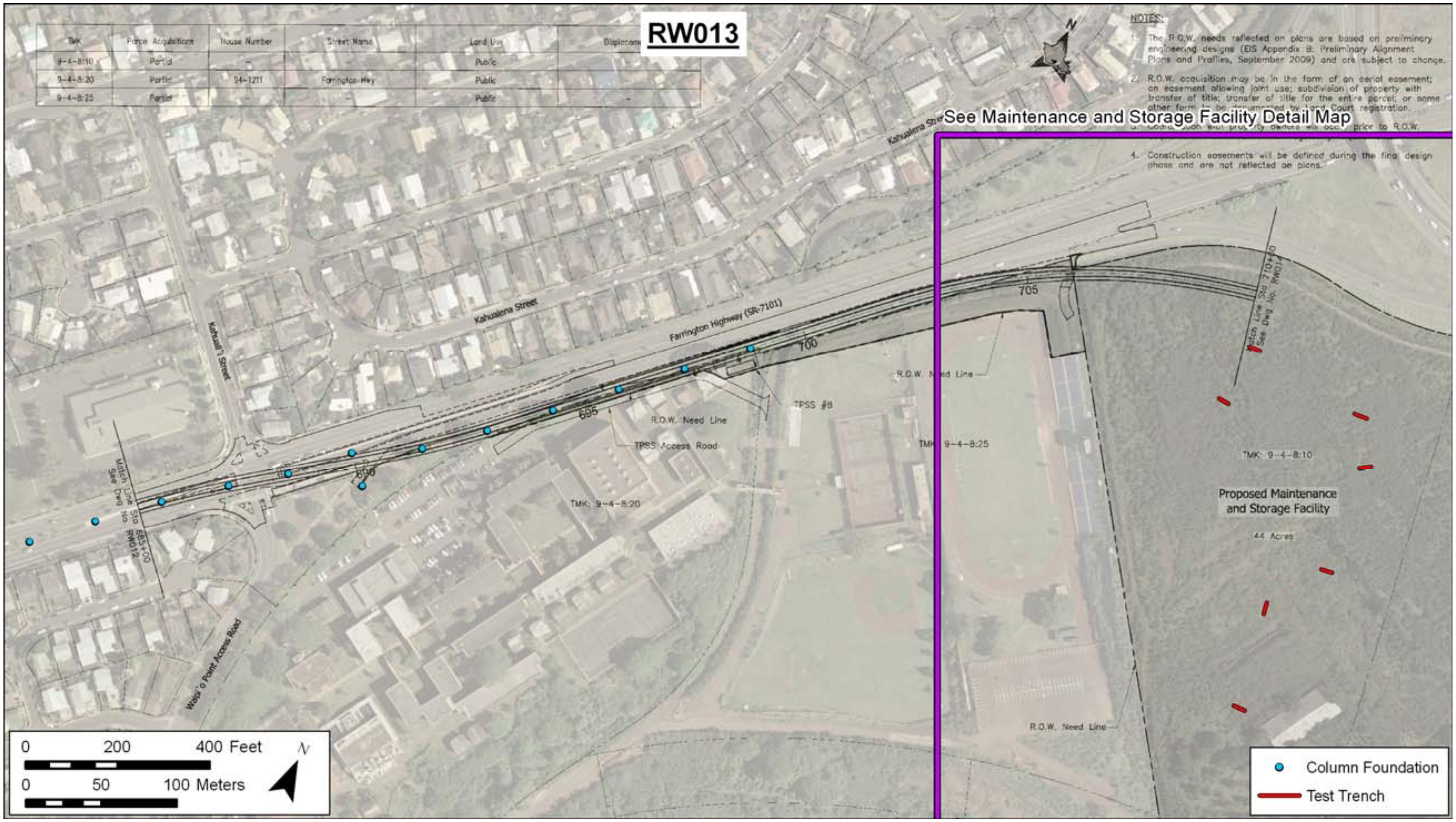

Figure 250. Construction Sheet RW013 showing the location of test excavations

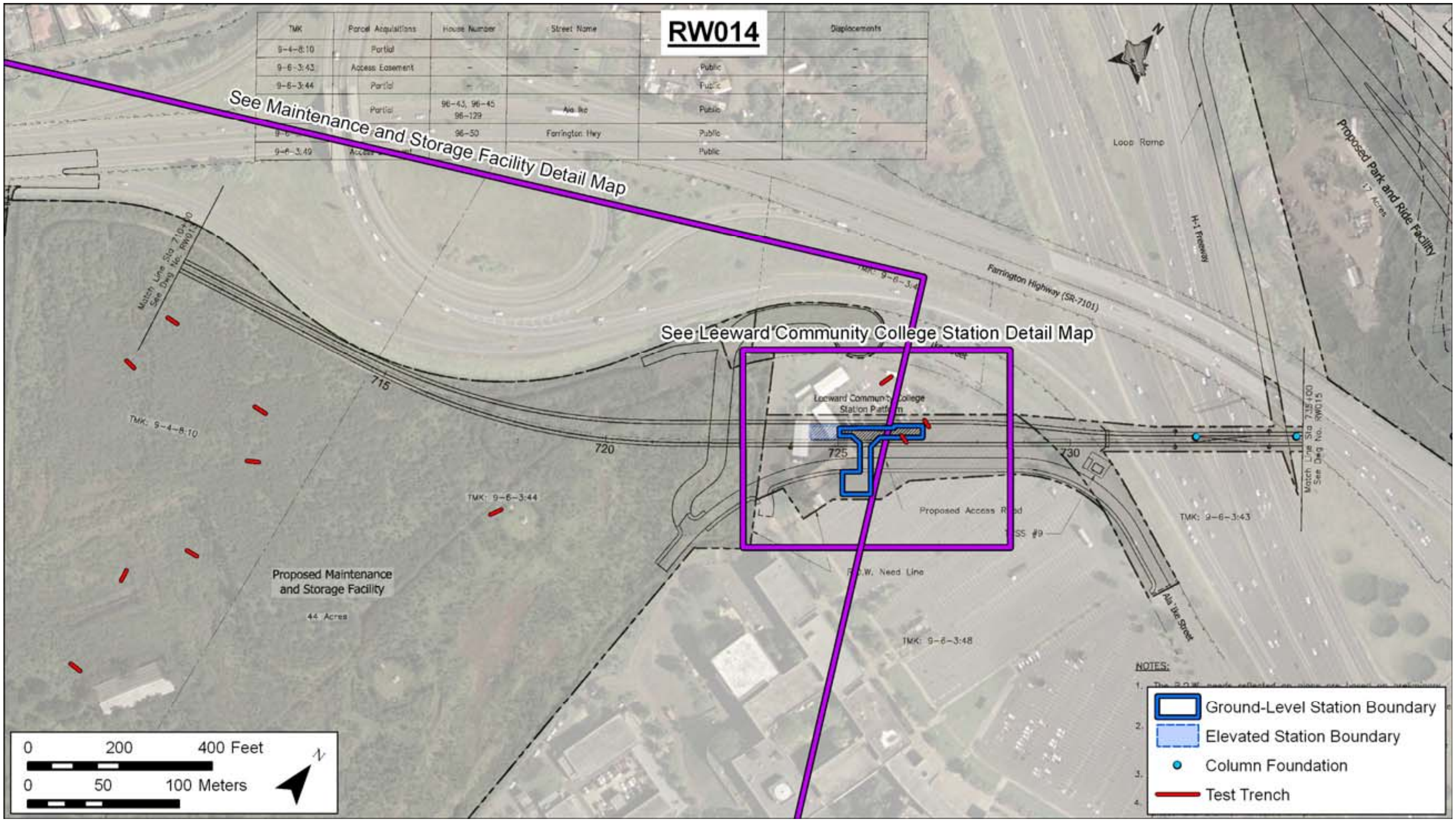

Figure 251. Construction Sheet RW014 showing the location of test excavations

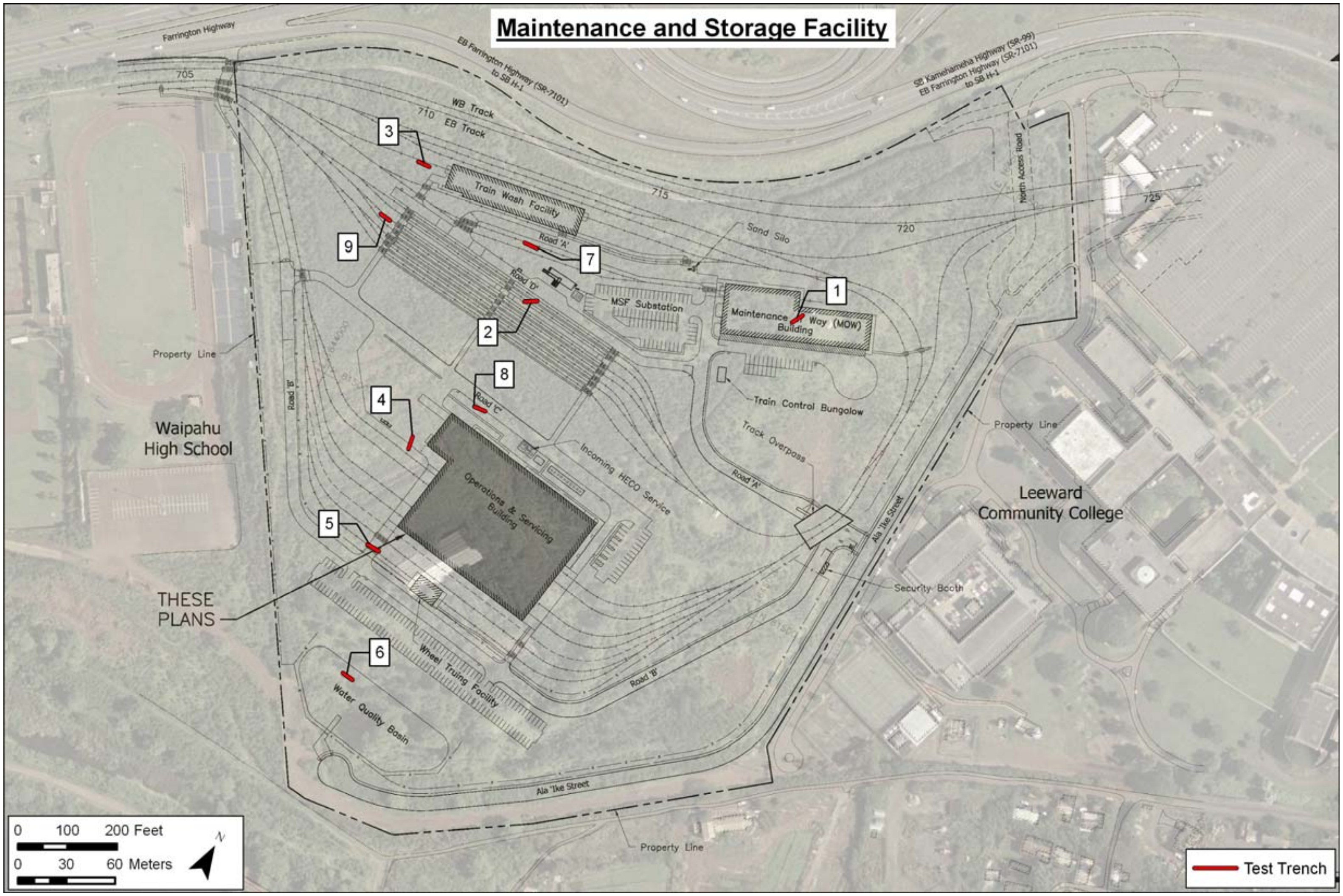

Figure 252. Maintenance and Storage Facility floor plan showing the location of test trenches

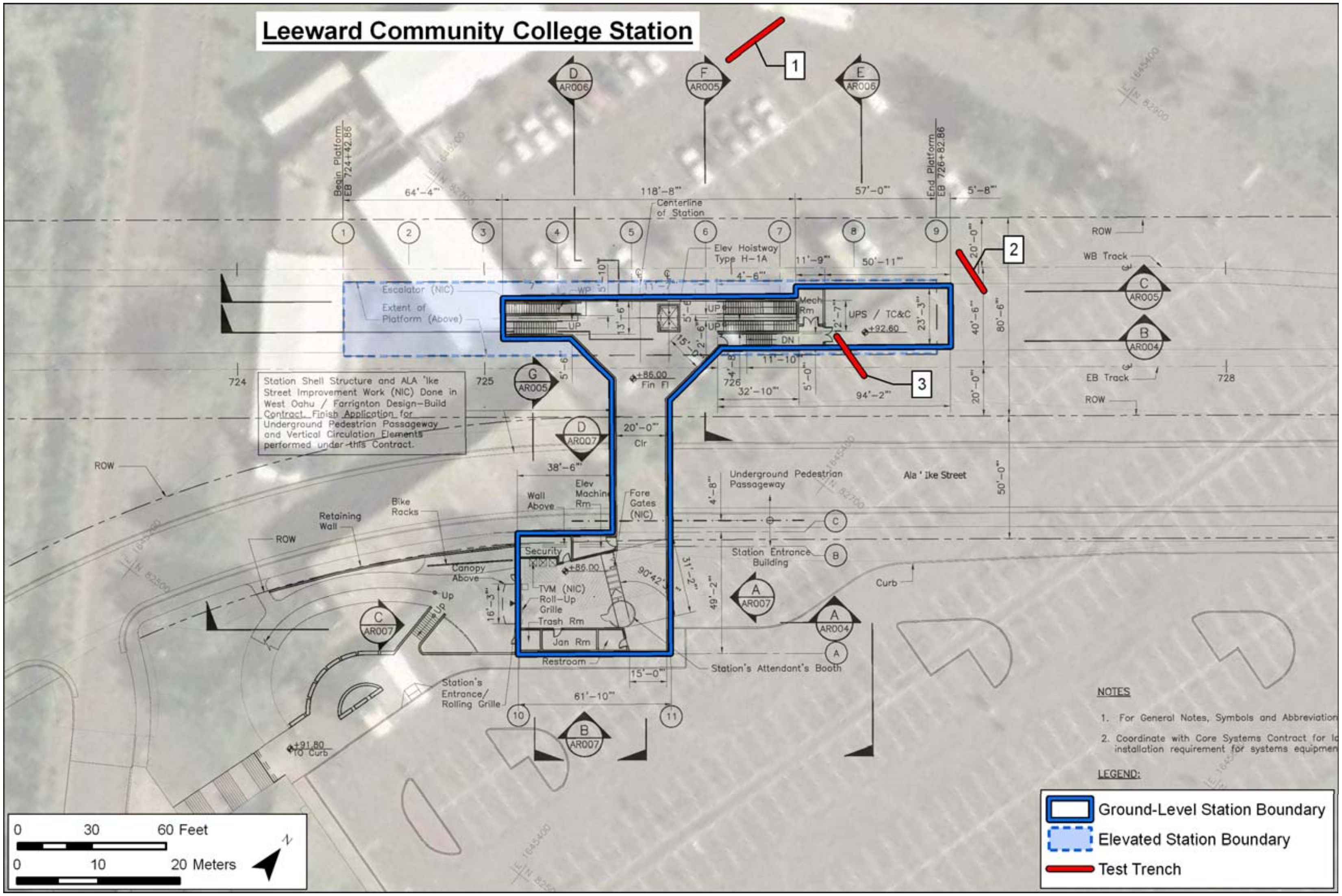

Figure 253. Leeward Community College Station floor plan showing the location of test trenches

Figure 254. Photo of the existing motorcycle safety course and parking area situated within locality for the LCC station

Figure 255. Photograph of parking area and administration building currently located within the vicinity of the proposed LCC station

4.13.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey was unable able to define stratigraphic interfaces within any of the test areas. The inability to discern stratigraphic interfaces in this area is likely due to the uniform stratigraphy of the area. In general, stratigraphic layers were denoted by color change, and not by sediment type and/or consistency. Thus there was not enough change in the dielectric constant between stratigraphic layers for the GPR to register stratigraphic interfaces. The exception to this was at the proposed LCC Station. At this location the GPR was able to isolate the interface between the asphalt road surface (and associated gravel base course) and the underlying silt loam (Figure 283, Figure 286, & Figure 289). GPR profiles at this location displayed horizontal banding from the surface to an approximate depth of 40 cm (Figure 285, Figure 288, & Figure 291). In this instance there was clearly a variation in dielectric constant between the asphalt, basalt gravel, and the underlying silt loam.

Also of note was the GPRs ability to detect areas where root activity was actively breaking down the soil (i.e. altering compaction and soil chemistry through root growth and decay). This was most clearly observed at Maintenance and Storage Facility Test Trench 1 & 7. Subsurface anomalies detected by the GPR appear to correspond to areas where root concentrations were observed during subsurface testing (Figure 256 thru Figure 258 & Figure 274 thru Figure 276). Thus at these locations the root activity created variations in the dielectric constant from the underlying compacted silt deposits.

4.13.3 Subsurface Testing

4.13.3.1 Stratigraphic Summary

Twelve (12) backhoe trenches were placed within the area delineated by Construction Sheet RW013 and RW014 (see Figure 250 thru Figure 253). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 256 to Figure 291).

The observed and documented stratigraphy within the Maintenance and Storage Facility consisted of varying layers of naturally deposited silt. In some instances limestone and basalt bedrock were encountered (see Figure 265 and Figure 271). These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

The observed and documented stratigraphy within the LCC Station consisted of varying layers of imported fill associated with parking lot construction, overlying naturally deposited silt.

These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.13.3.2 Excavation Documentation

Maintenance and Storage Facility Test Trench 1

Orientation	15° TN
Length	8 m
Width	0.7 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
I	0-250	10 YR 3/4, dark yellowish brown; silt loam; structureless; dry weakly coherent consistency; non plastic; no cementation; mixed origin; abrupt broken lower boundary. Contained crushed coral and basalt cobbles. Previously disturbed naturally deposited sediment. Disturbance likely associated with prior military development (i.e. grading for access roads).
II	80-250	10 YR 4/4, dark yellowish brown; silt; structureless; dry very hard consistency; non-plastic; strong cementation; terrestrial origin. Naturally deposited sediment.

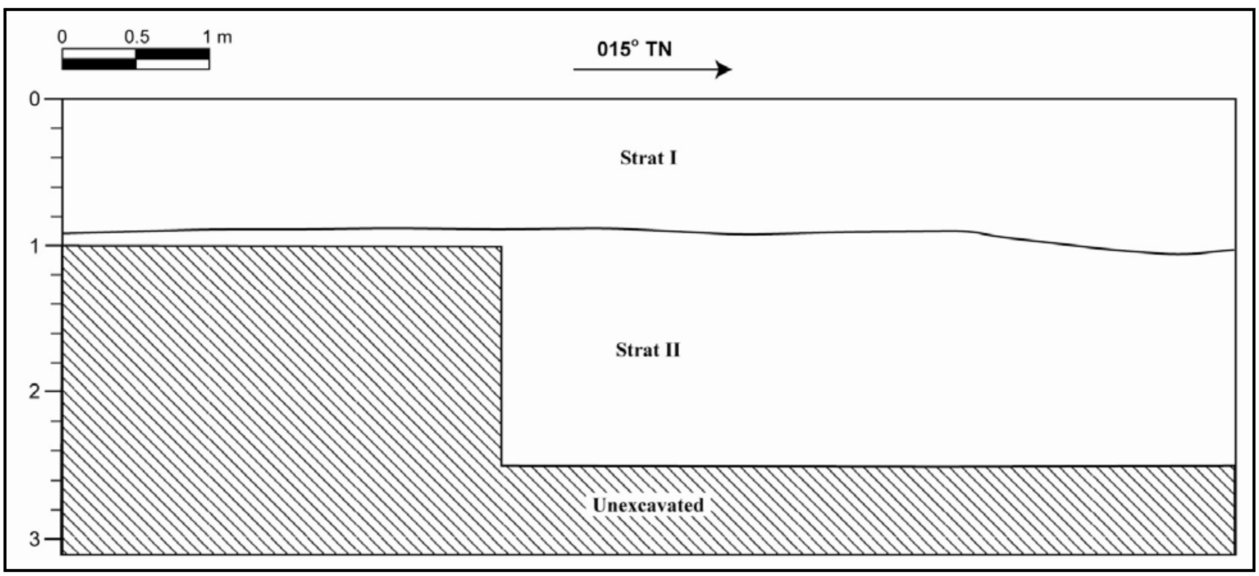

Figure 256. Profile of Maintenance and Storage Facility Test Trench 1

Figure 257. Photograph of Maintenance and Storage Facility Test Trench 1, view to west

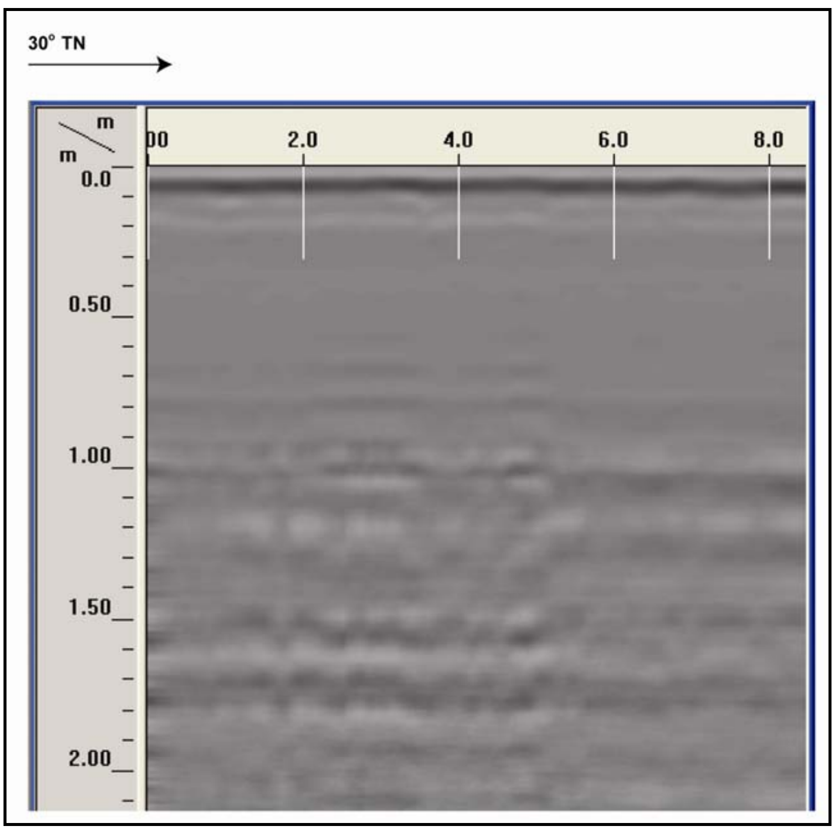

Figure 258. GPR profile of Maintenance and Storage Facility Test Trench 1

Maintenance and Storage Facility Test Trench 2

Orientation	57° TN
Length	7 m
Width	0.7 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
I	0-20	A-Horizon; 10 YR 5/3, brown; silt loam; structureless; dry loose consistency; non-plastic; no cementation; terrestrial origin; clear wavy lower boundary; modern A-Horizon.
II	20-210	B-Horizon; 10 YR 3/4 dark yellowish brown; silt; strong coarse crumb structure; dry extremely hard; non-plastic; strong cementation. Naturally deposited sediment.

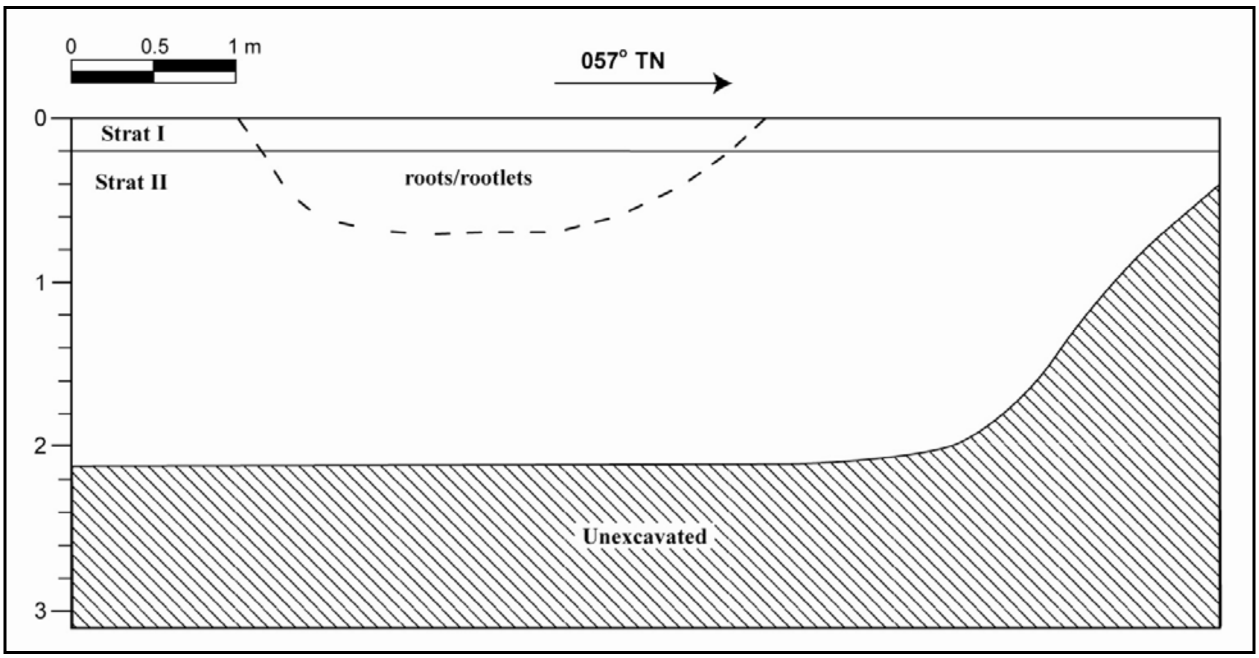

Figure 259. Profile of Maintenance and Storage Facility Test Trench 2

Figure 260. Photograph of Maintenance and Storage Facility Test Trench 2, view to north

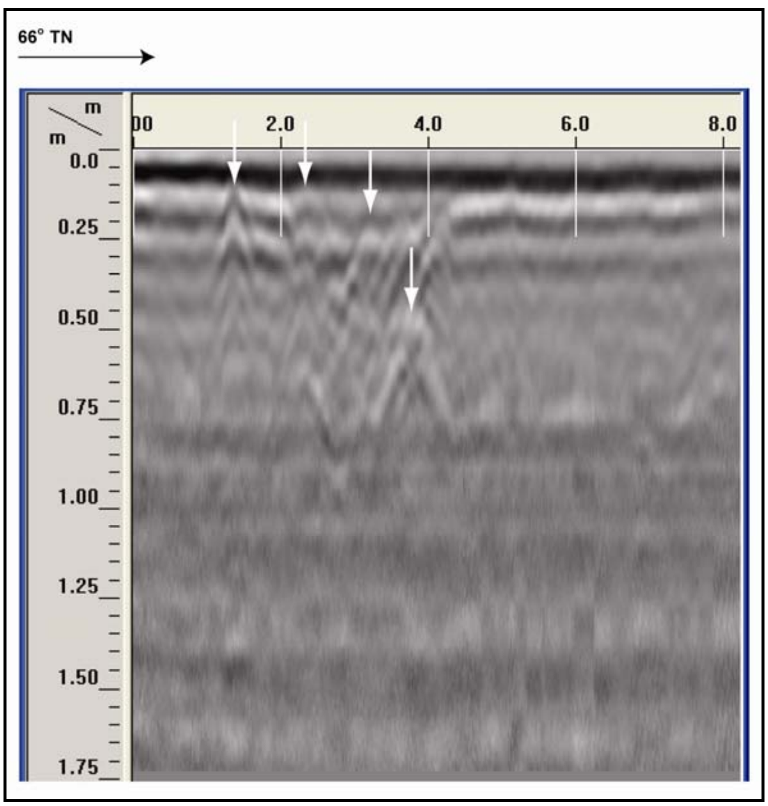

Figure 261. GPR profile of Maintenance and Storage Facility Test Trench 2

Maintenance and Storage Facility Test Trench 3

Orientation	93° TN
Length	8 m
Width	0.7 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
I	0-250	10 YR 3/4, dark yellowish brown; silt; structurless; dry weakly coherent consistency; non-plastic; strong cementation; terrestrial origin. Top 100cm of stratum contains roots and rootlets, which are beginning to break down the sediment.

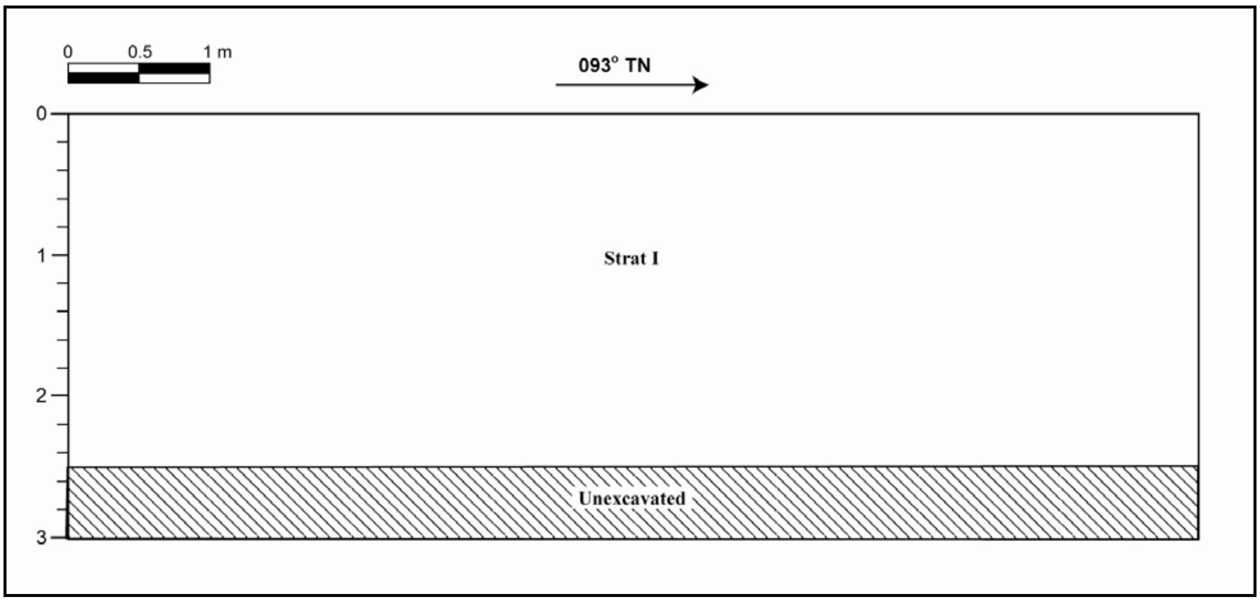

Figure 262. Profile of Maintenance and Storage Facility Test Trench 3

Figure 263. Photograph of Maintenance and Storage Facility Test Trench 3, view to north

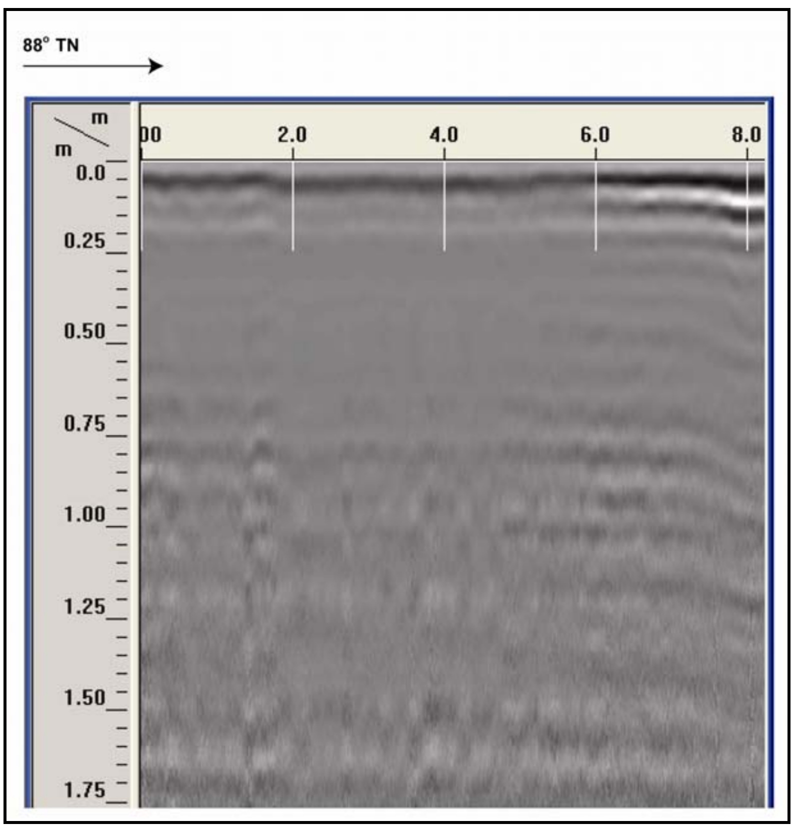

Figure 264. GPR profile of Maintenance and Storage Facility Test Trench 3

Maintenance and Storage Facility Test Trench 4

Orientation	153° TN
Length	8 m
Width	0.7 m
Maximum Depth	150 m

Stratum	Depth (cmbs)	Description
I	0-20	A-Horizon; 10 YR 3/4, dark yellowish brown; silty clay loam; weak fine granular structure; dry weakly coherent consistency; slightly plastic; weak cementation; terrestrial; clear smooth lower boundary. Contains roots. Modern A-Horizon.
II	20-150	10 YR 4/3, brown; silt; strong blocky structure; dry extremely hard consistency; non-plastic; indurated cementation; mixed origin. Contains large amounts of decomposing limestone.

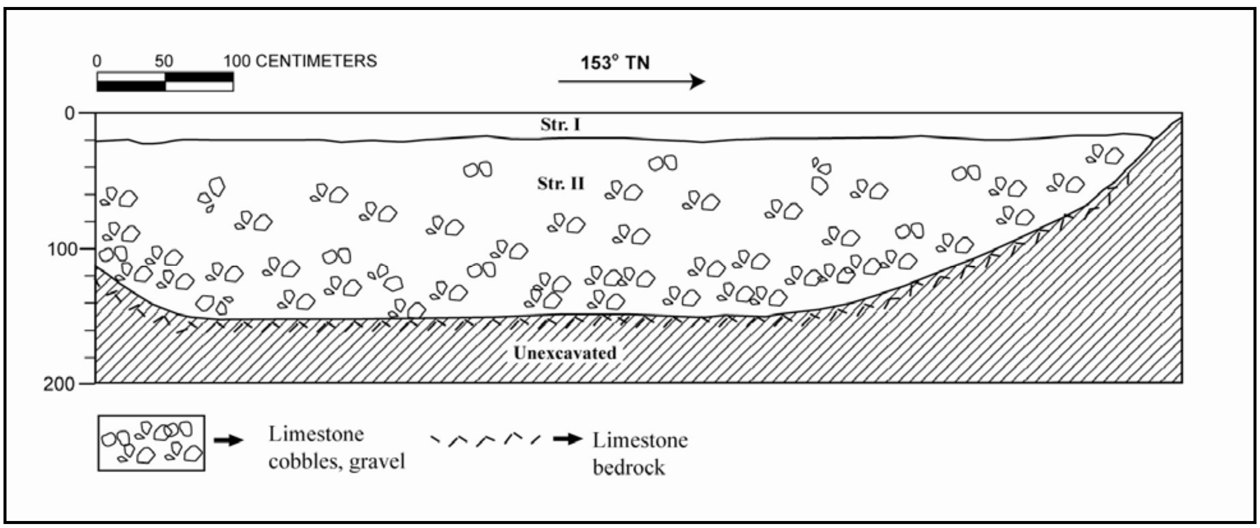

Figure 265. Profile of Maintenance and Storage Facility Test Trench 4

Figure 266. Photograph of Maintenance and Storage Facility Test Trench 4, view to east

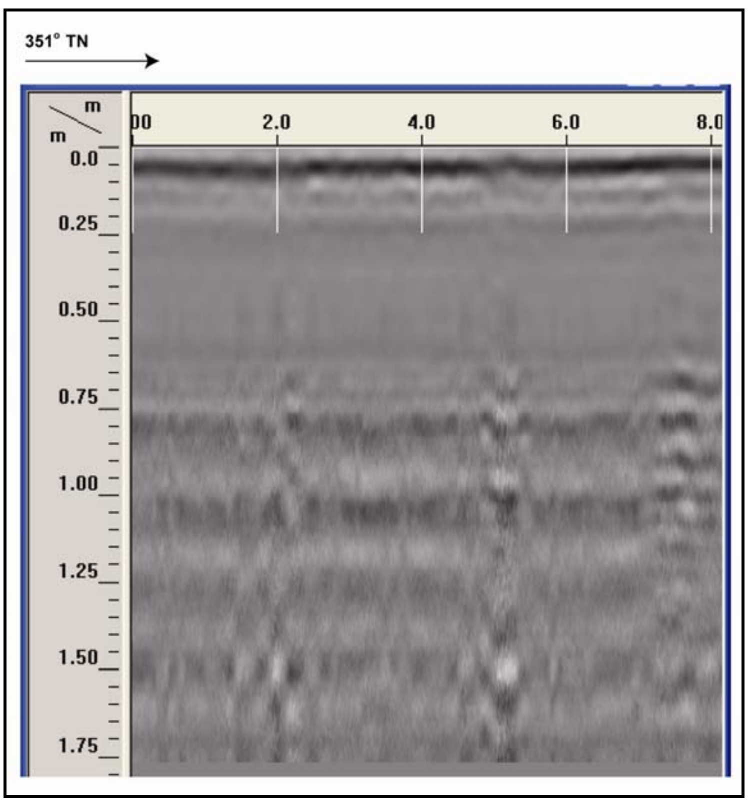

Figure 267. GPR profile of Maintenance and Storage Facility Test Trench 4

Maintenance and Storage Facility Test Trench 5

Orientation	90° TN
Length	8m
Width	0.7m
Maximum Depth	2.5m

Stratum	Depth (cmbs)	Description
Ia	0-150	10 YR 3/6, dark yellowish brown; silt; structurless; dry loose to weakly coherent consistency; non-plastic; strong cementation; terrestrial clear wavy lower boundary. Naturally deposited sediment.
Ib	150-250	5 YR 2.5/2, dark reddish brown; silt; structurless; dry extremely hard consistency; non-plastic; strong cementation; terrestrial origin. Naturally deposited sediment.

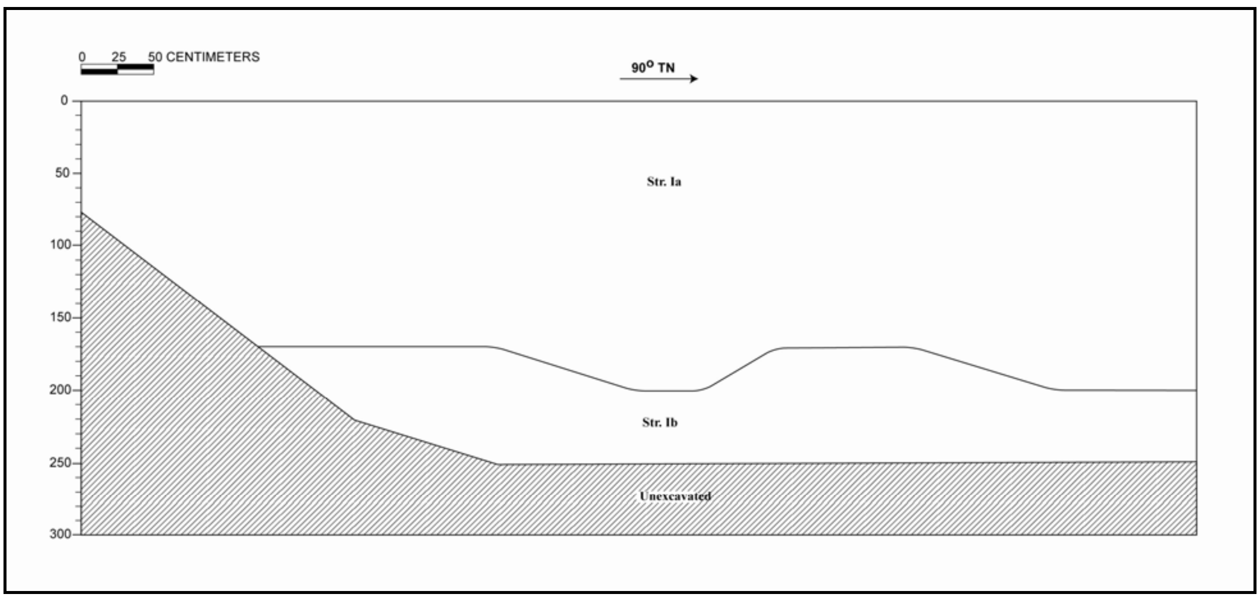

Figure 268. Profile of Maintenance and Storage Facility Test Trench 5

Figure 269. Photograph of Maintenance and Storage Facility Test Trench 5, view to north

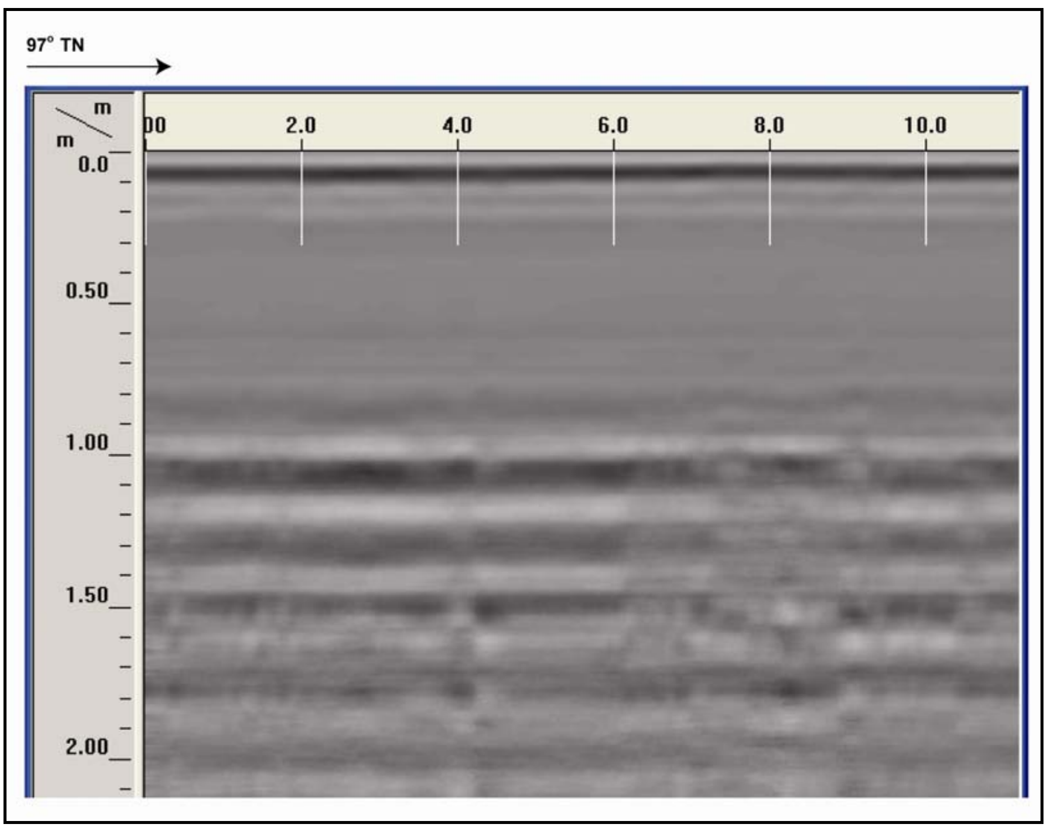

Figure 270. GPR profile of Maintenance and Storage Facility Test Trench 5

Maintenance and Storage Facility Test Trench 6

Orientation	80° TN
Length	7.3m
Width	0.7m
Maximum Depth	2.2m

Stratum	Depth (cmbs)	Description
I	0-200	7.5 YR 3/3, dark brown; silty clay loam; moderate medium blocky structure; dry very hard consistency; slightly plastic; strong cementation; terrestrial origin; diffuse smooth lower boundary. Soil compaction increases with depth.
II	200-220	C-Horizon; 10 YR 5/4, yellowish brown; strong coarse blocky structure; dry extremely hard consistency; slightly plastic; strong cementation; terrestrial origin; decomposing basalt bedrock.

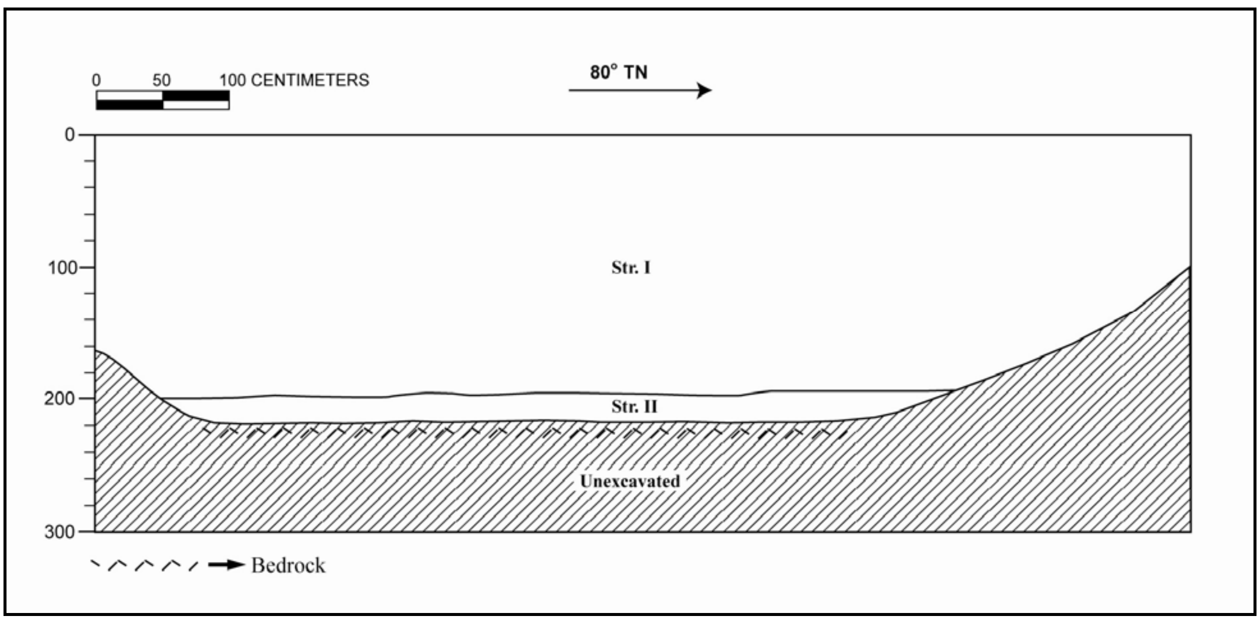

Figure 271. Profile of Maintenance and Storage Facility Test Trench 6

Figure 272. Photograph of Maintenance and Storage Facility Test Trench 6, view to north

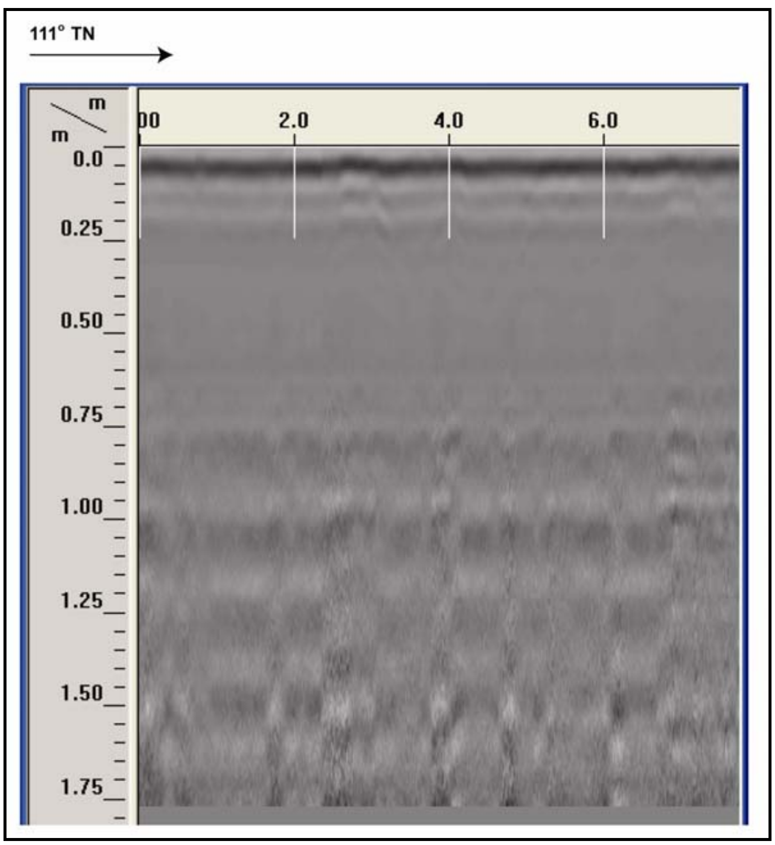

Figure 273. GPR profile of Maintenance and Storage Facility Test Trench 6

Maintenance and Storage Facility Test Trench 7

Orientation	56° TN
Length	8m
Width	0.7m
Maximum Depth	205m

Stratum	**Depth (cmbs)**	**Description**
I	0-25	Crushed coral fill
II	25-205	10 YR 4/4, dark yellowish brown; silt; strong medium crumb structure; dry hard consistency; non-plastic; strong cementation; terrestrial origin. Naturally deposited sediment.

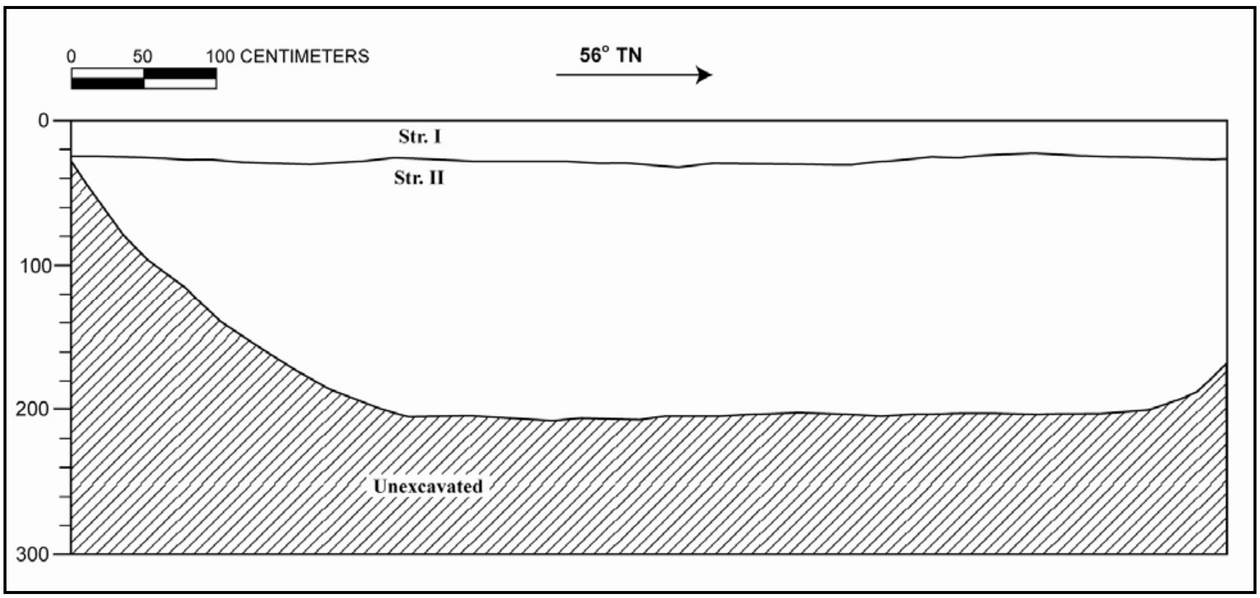

Figure 274. Profile of Maintenance and Storage Facility Test Trench 7

Figure 275. Photograph of Maintenance and Storage Facility Test Trench 7, view to north

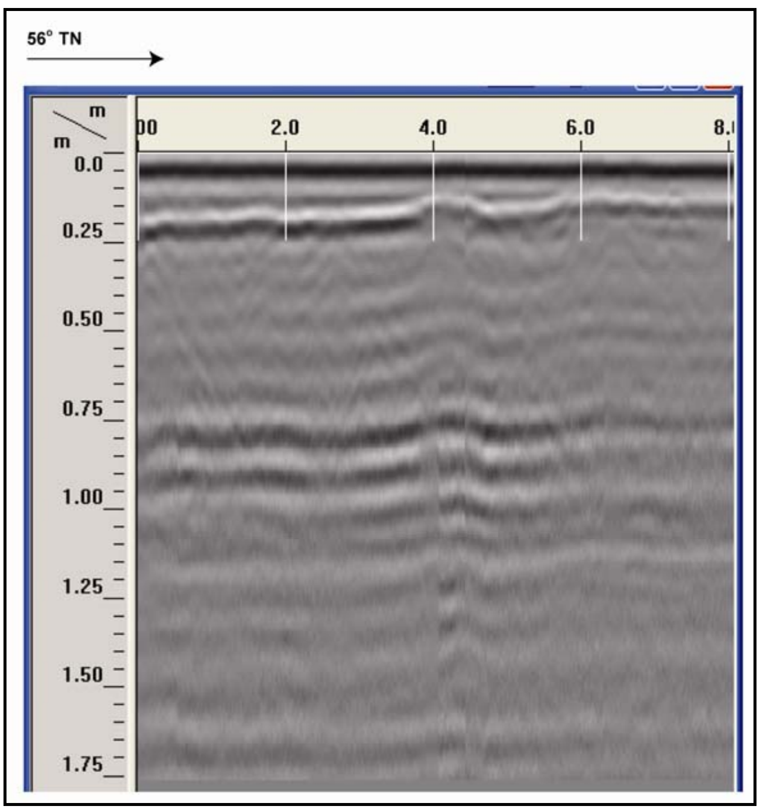

Figure 276. GPR profile of Maintenance and Storage Facility Test Trench 7

Maintenance and Storage Facility Test Trench 8

Orientation	102° TN
Length	8m
Width	0.7m
Maximum Depth	2.6m

Stratum	Depth (cmbs)	Description
I	0-60	A-Horizon; 10 YR 3/3 dark brown; silt loam; weak fine granular structure; weakly coherent consistency; non-plastic; weak cementation; terrestrial origin; clear wavy lower boundary. Modern A-horizon.
II	60-260	10 YR 4/3, brown; silt loam; strong medium blocky structure; dry very hard consistency; non-plastic; strong cementation; terrestrial origin.

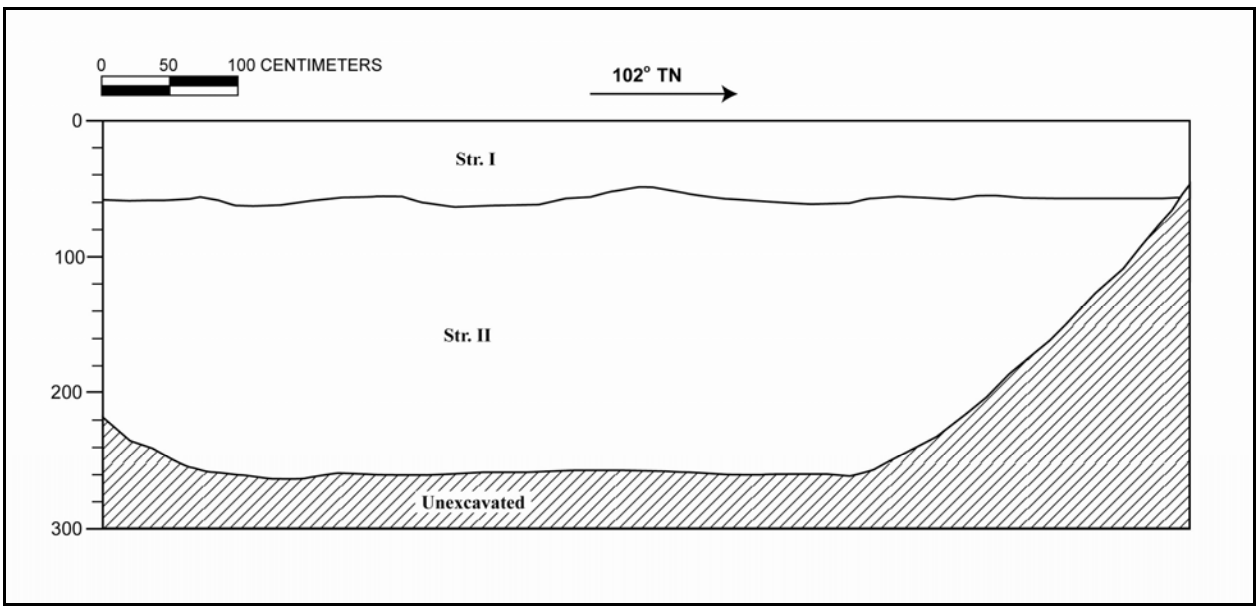

Figure 277. Profile of Maintenance and Storage Facility Test Trench 8

Figure 278. Photograph of Maintenance and Storage Facility Test Trench 8, view to north

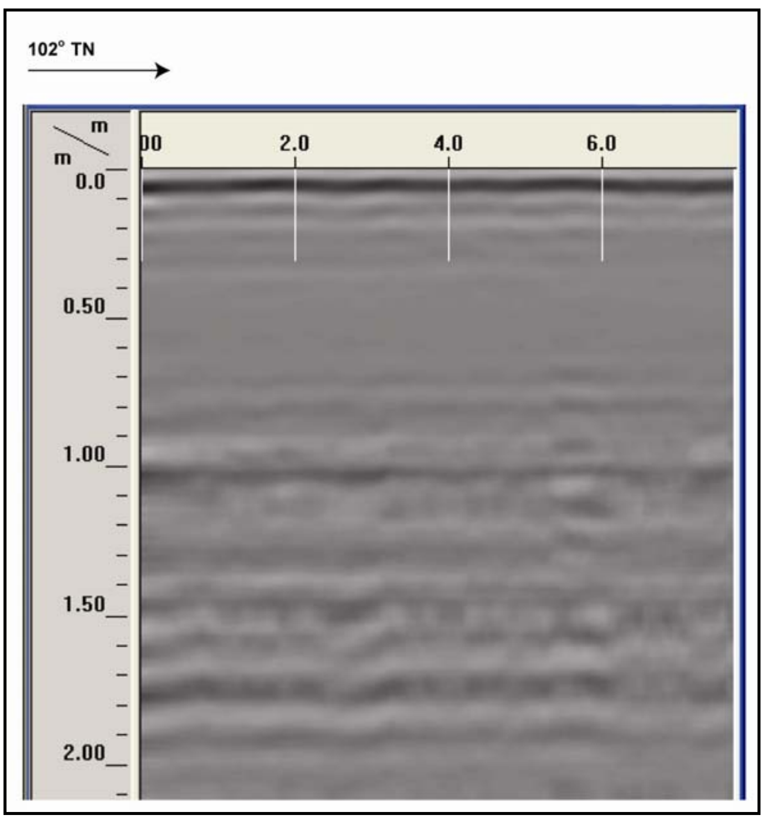

Figure 279. GPR profile of Maintenance and Storage Facility Test Trench 8

Maintenance and Storage Facility Test Trench 9

Orientation	90° TN
Length	6m
Width	0.7m
Maximum Depth	2.5m

Stratum	Depth (cmbs)	Description
I	0-250	10 YR 4/4, dark yellowish brown; silt loam; strong medium blocky structure; dry very hard consistency; non-plastic; strong cementation; terrestrial origin; roots extend to 1 meter below surface. Soil compaction increases with depth.

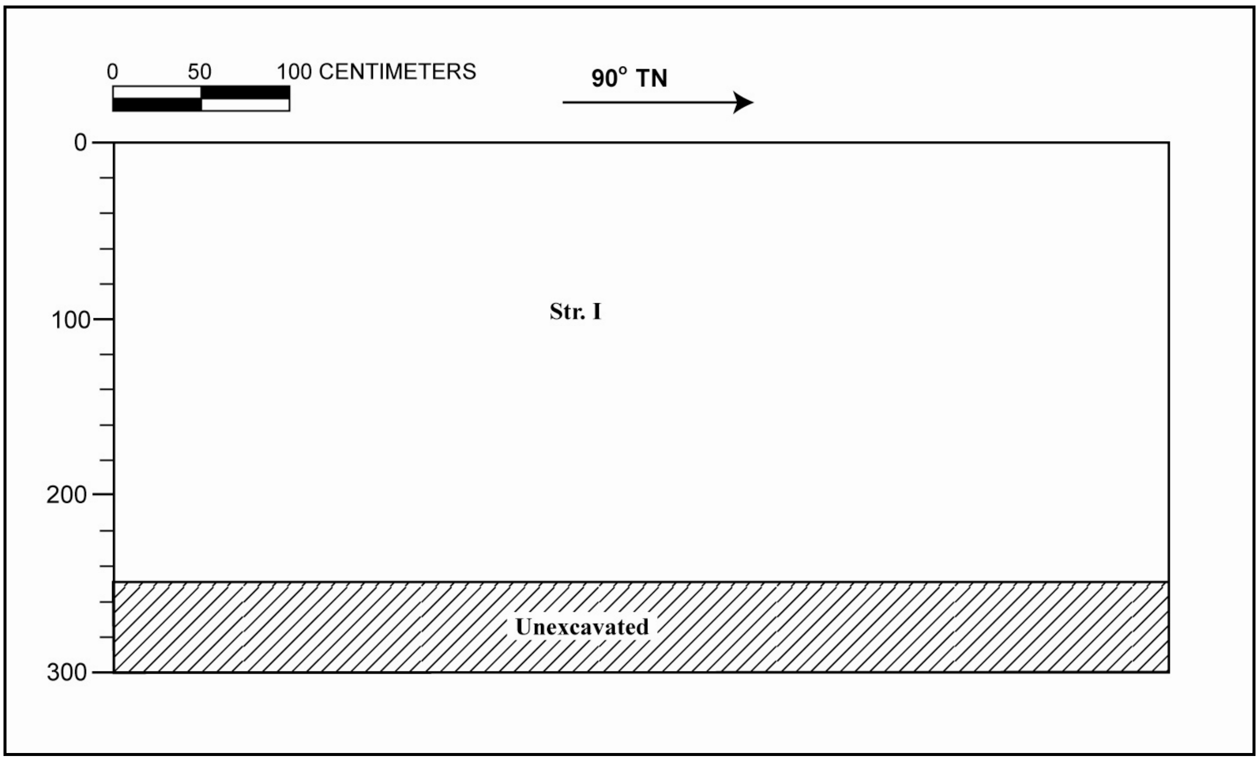

Figure 280. Profile of Maintenance and Storage Facility Test Trench 9

Figure 281. Photograph of Maintenance and Storage Facility Test Trench 9, view to south

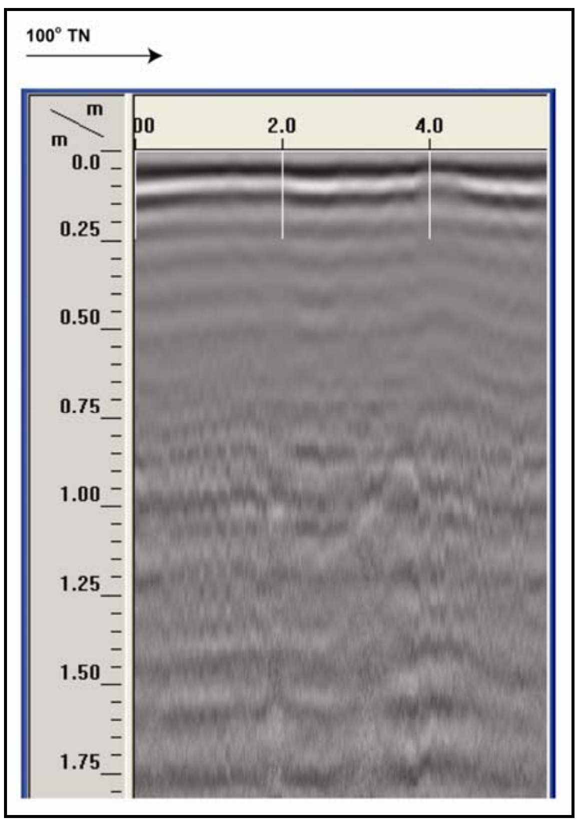

Figure 282. GPR profile of Maintenance and Storage Facility Test Trench 9

Leeward Community College Station Test trench 1

Orientation	200° TN
Length	8 m
Width	0.8 m
Maximum Depth	3.8 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-380	5 YR 4/3, reddish brown; silt loam; strong medium blocky structure; dry hard consistency; non-plastic; weak cementation; terrestrial origin. Naturally deposited sediment.

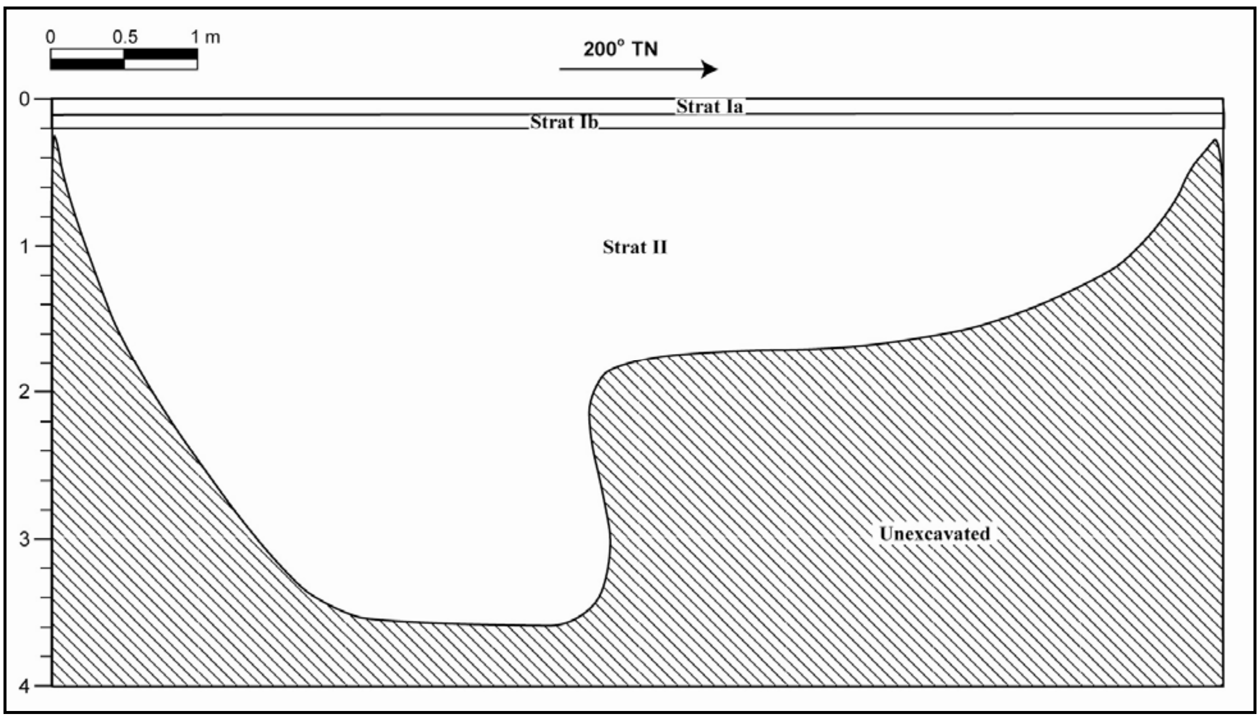

Figure 283. Profile of Leeward Community College Station Test trench 1

Figure 284. Photograph of Leeward Community College Station Test trench 1, view to east

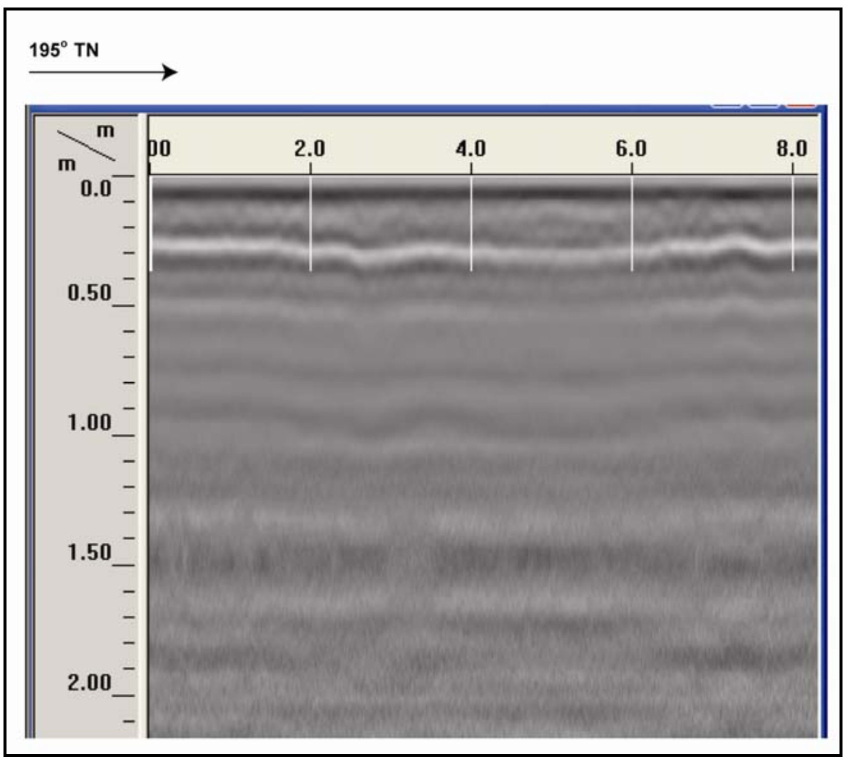

Figure 285. GPR profile of Leeward Community College Station Test trench 1

Leeward Community College Station Test trench 2

Orientation	110° TN
Length	5 m
Width	0.8 m
Maximum Depth	3.5 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-350	5 YR 4/3, reddish brown; silt loam; strong medium blocky structure; dry hard consistency; non-plastic; weak cementation; terrestrial origin. Naturally deposited sediment.

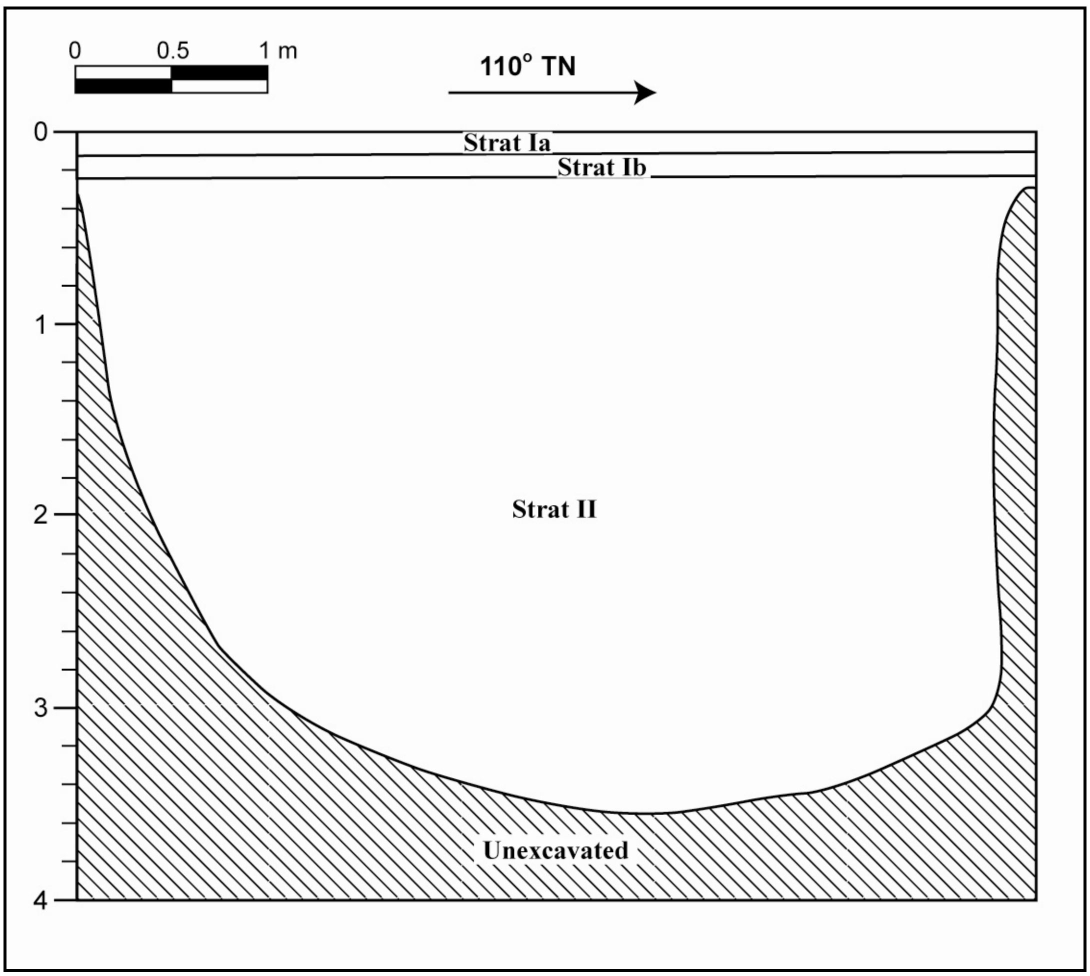

Figure 286. Profile of Leeward Community College Station Test trench 2

Figure 287. Photograph of Leeward Community College Station Test trench 2, view to north

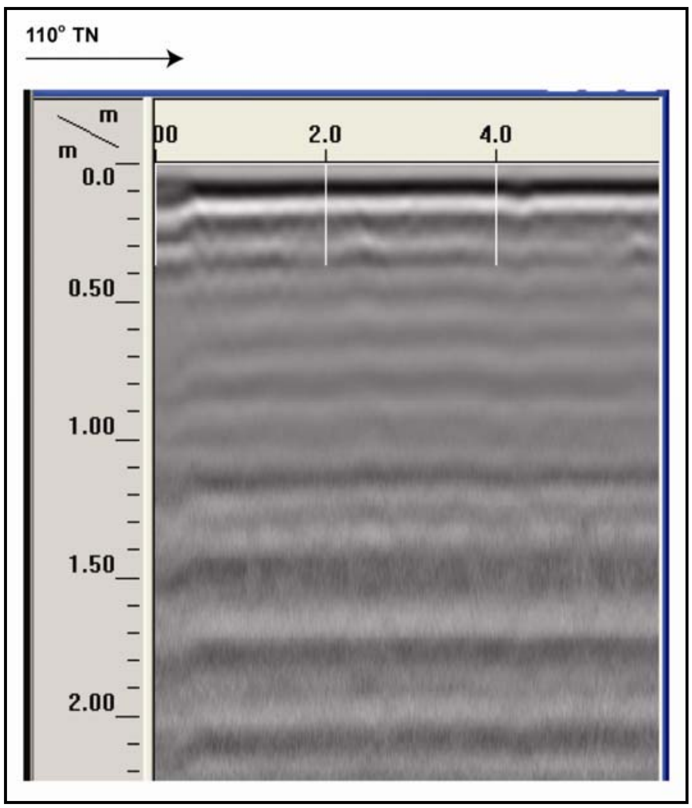

Figure 288. GPR profile of Leeward Community College Station Test trench 2

Leeward Community College Station Test trench 3

Orientation	110° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-210	5 YR 4/3, reddish brown; silt loam; strong medium blocky structure; dry hard consistency; non-plastic; weak cementation; terrestrial origin. Naturally deposited sediment.

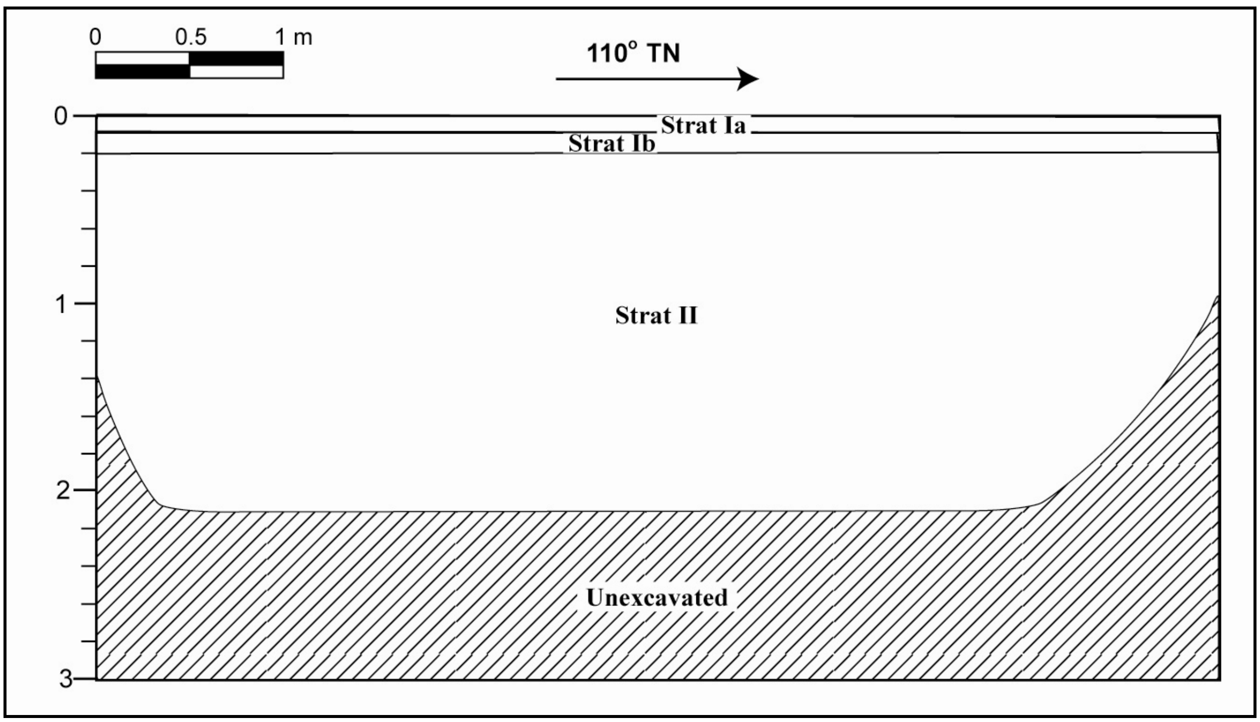

Figure 289. Profile of Leeward Community College Station Test trench 3

Figure 290. Photograph of Leeward Community College Station Test trench 3, view to north

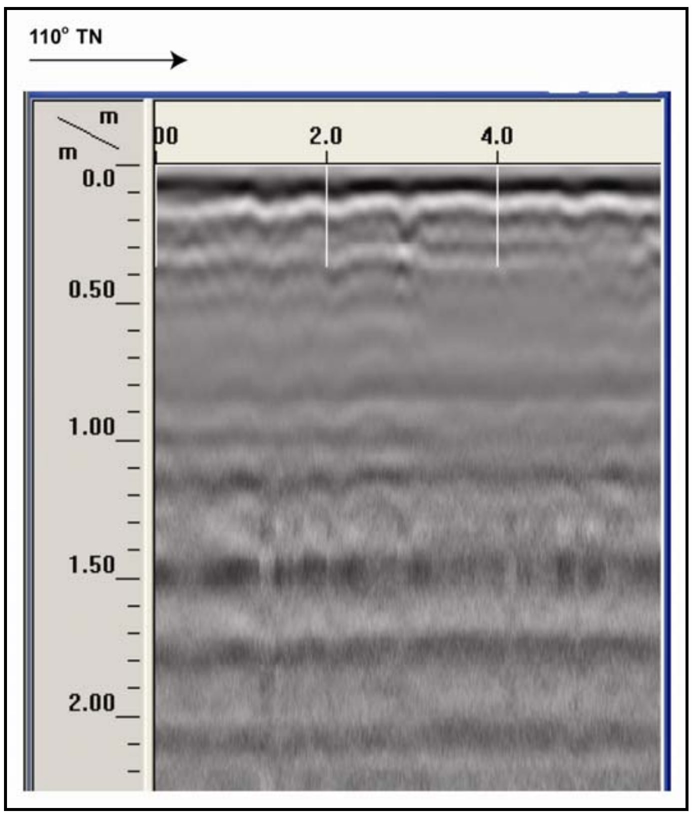

Figure 291. GPR profile of Leeward Community College Station Test trench 3

4.14 Construction Sheet RW015

Construction Sheet RW015 includes a 3,500 ft (1.0 km) segment of the proposed transit corridor, and includes the proposed Pearl Highlands Station and Park and Ride Facility (Figure 292). Eleven test trenches were excavated at both the station and park and ride (Figure 293). Additionally, five column test pits (C-32 to C-36) were also excavated (see Figure 292), totaling 16 test excavations within Construction Sheet RW015.

4.14.1 Pedestrian Inspection

The area defined by Construction Sheet RW015 consists of a roughly 17-acre area proposed for the development of the Pearl Highlands Station and Park and Ride Facility. Current land uses include residential housing, a community church, a construction base yard, and as a storage area for scrap metal. Waiawa Stream flows east along the south side of this area.

In consultation with one of the current landowners, it was ascertained that the area was highly modified from its natural state, as a large amount of fill had been deposited all the way up to the streamside to enable development of the area. According to this landowner, these fill layers were brought in over time between 30 and 40 years ago (Mr. Sam Alipio, personal communication 15 September 2009).Various trees, brush, and grasses grow all about with some being cultivated by the tenants, others growing wildly. High amounts of debris and broken vehicles lay all about the entire vicinity. A mix of dilapidated structures and renovated houses are built about the area (Figure 294).

Development associated with land filling and construction activities within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.14.2 GPR Survey

Prior to excavation all test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

Throughout the entire area defined by Construction Sheet RW015 (excluding C-34 to C-36), the GPR had limited ability to detect buried land fill deposits (asphalt, concrete, cars, home appliances, etc.) and associated subsurface disturbances. Buried objects did not always corresponded with subsurface anomalies detected by the GPR (see Figure 295 thru Figure 333). Only a fraction of the buried debris observed during test excavation were detected by the GPR, and that radar depth penetration (aka “visibility”) was limited to an approximate depth of 1 m.

The GPR was generally able to detect stratigraphic interfaces and areas of previous disturbance. Stratigraphic interfaces corresponded to horizontal banding displayed in GPR profiles and areas of disturbance corresponded to irregular horizontal banding that was discontinuous (Figure 298 thru Figure 300 & Figure 313 thru Figure 324).

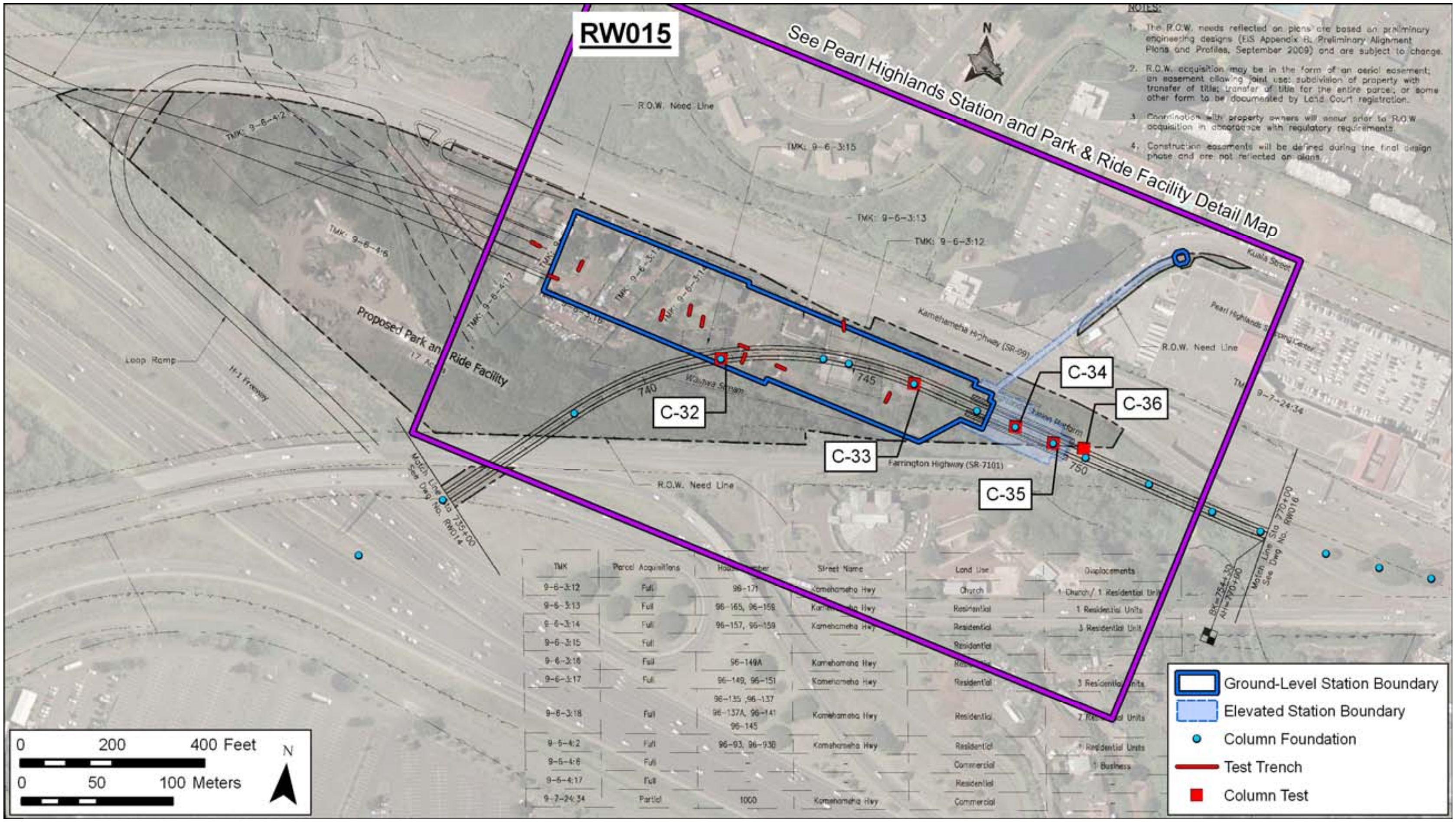

Figure 292. Construction Sheet RW015 showing the location of test excavations

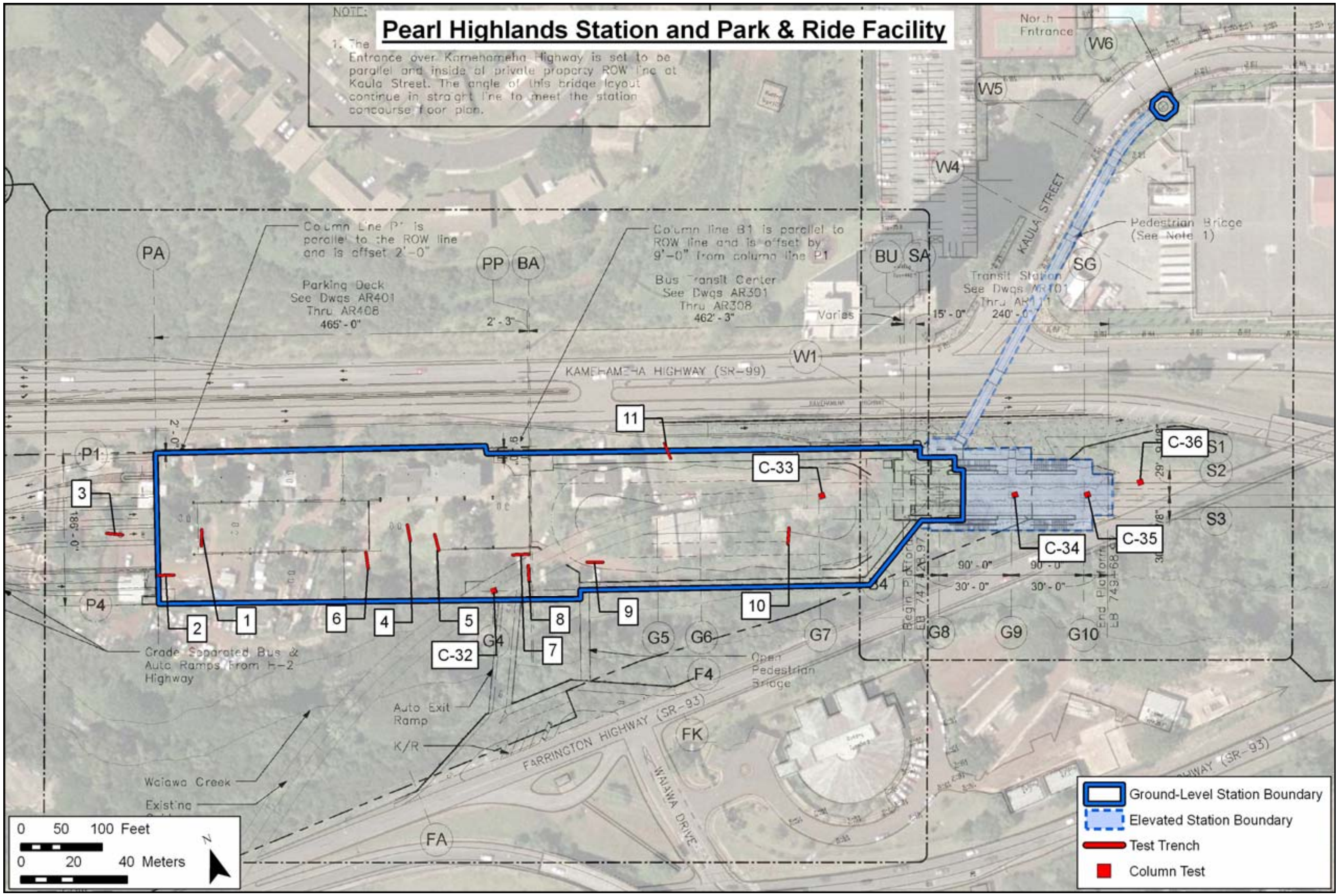

Figure 293. Pearl Highlands Station and Park and Ride Facility floor plan showing the location of test trenches

Figure 294. Photograph of residential dwellings within the project area proposed for the Pearl Highlands Transit Station and Park and Ride facility.

The results of the GPR survey were inconclusive. While the GPR was able to detect buried objects and areas of previous disturbance, it did not detect all buried objects and had a limited depth of view, restricted to an approximate depth of l m. It is believed that soil chemistry was theprimary environmental factor that caused the inconsistent and limited GPR results. The mixed GPR results in this area are consistent with the NRCS, which determined a GPR suitability of moderate to low for this area (see Figure 9).

4.14.3 Subsurface Testing

4.14.3.1 Stratigraphic Summary

Sixteen (16) test excavations were placed within the area delineated by Construction Sheet RW015 (see Figure 292 & Figure 293). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 295 to Figure 340).

In general, the observed and documented stratigraphy consisted of varying layers of fill. Fill events were determined to be associated with residential and agricultural development, as well as extensive garbage dumping. Large amounts of modern garbage (concrete, automobiles, home appliances, plastic, etc.) were observed concentrated beneath the ground surface suggesting that the area was once utilized as a dump and landfill. All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

In only three of the 16 test excavations (Trench 2 and 3 and Column excavation 34) excavated within the area delinated by Construction Sheet RW015 (see Figure 292 & Figure 293) were what appeared to be natural (e.g. non-fill related) sediments observed. These sediments, in all cases designated stratum II, were observed at the base of their backhoe excavations, beneath between two and three meters of recently deposted fill sediments. No cultural material was observed with these natural sediments. They appeared to be the types of alluvial sediments that would be expected along the margins of Waiawa Stream. These sediments were likely the land surface as recently as 30 to 40 years ago, before the massive fill layers were brought in to raise the land surface to its current elevation above Waiawa Stream.

4.14.3.2 Excavation Documentation

Pearl Highlands Station and P&R Test Trench 1

Orientation	20° TN
Length	4 m
Width	0.7 m
Maximum Depth	280 m

Stratum	Depth (cmbs)	Description
Ia	0-70	Fill Horizon; 2.5 YR 4/6, red; sandy loam; structureless, firm moist consistency; slightly plastic; no cementation; very abrupt smooth lower boundary; Grading fill.
Ib	70-80	Fill Horizon; 10 YR 6/4, light yellowish brown; sandy loam; structureless, firm moist consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Grading fill.
Ic	80-96~103	Fill Horizon; 2.5 YR 5/8, red; silt loam; structureless, very firm moist consistency; plastic; no cementation; clear wavy lower boundary; Grading fill.
Id	96~103-173	Fill Horizon; 2.5 YR 5/2, weak red; clay loam; structureless, friable moist consistency; plastic; no cementation; abrupt wavy lower boundary; Grading fill.
Ie	173-220	Fill Horizon; 5 YR 5/2, reddish gray; stony, cobbly, silty sand; structureless, firm moist consistency; non-plastic; no cementation;; excavation terminated due to impenetrable fill layer, grading fill.

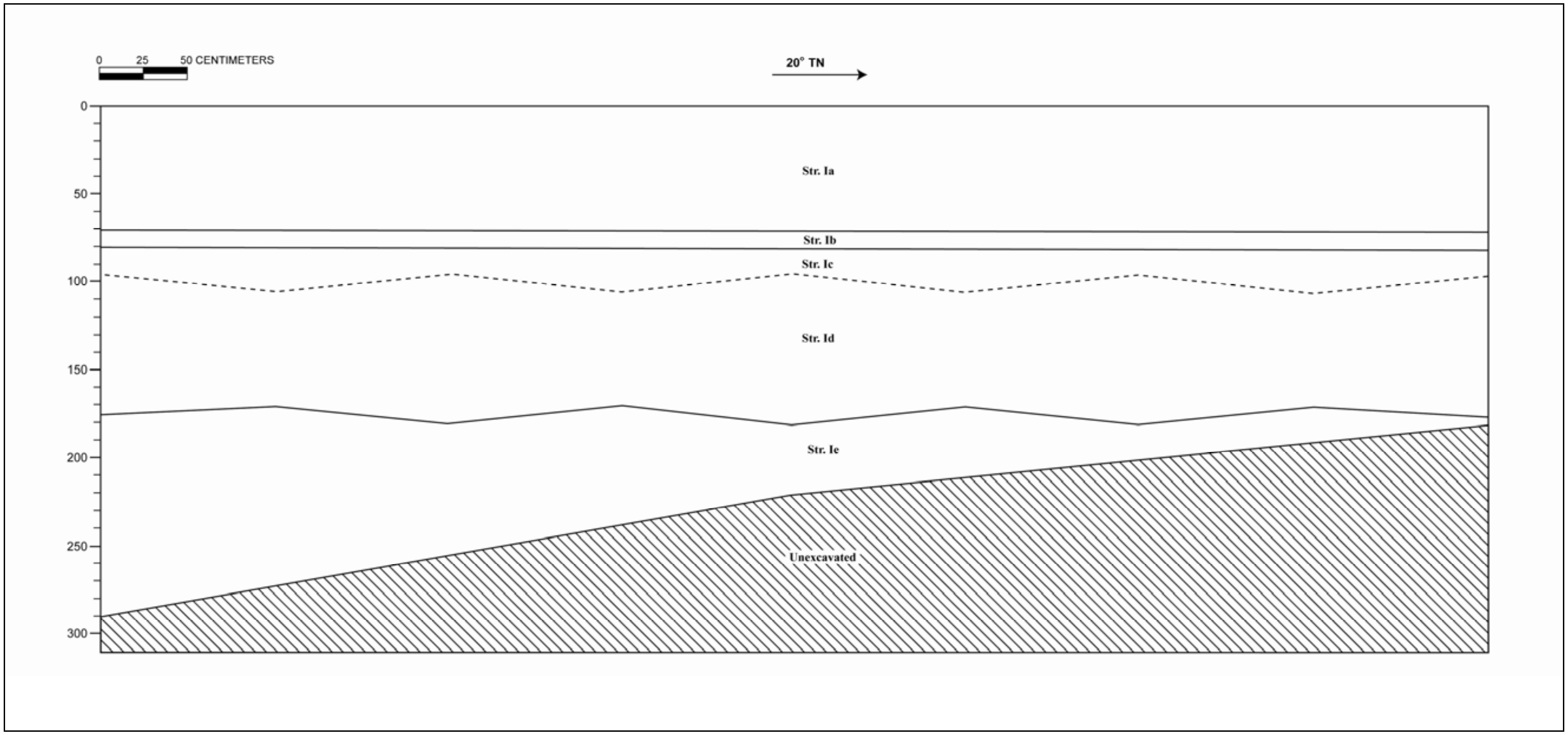

Figure 295. Profile of Pearl Highlands Station and P&R Test Trench 1

Figure 296. Photograph of Pearl Highlands Station and P&R Test Trench 1, view to west

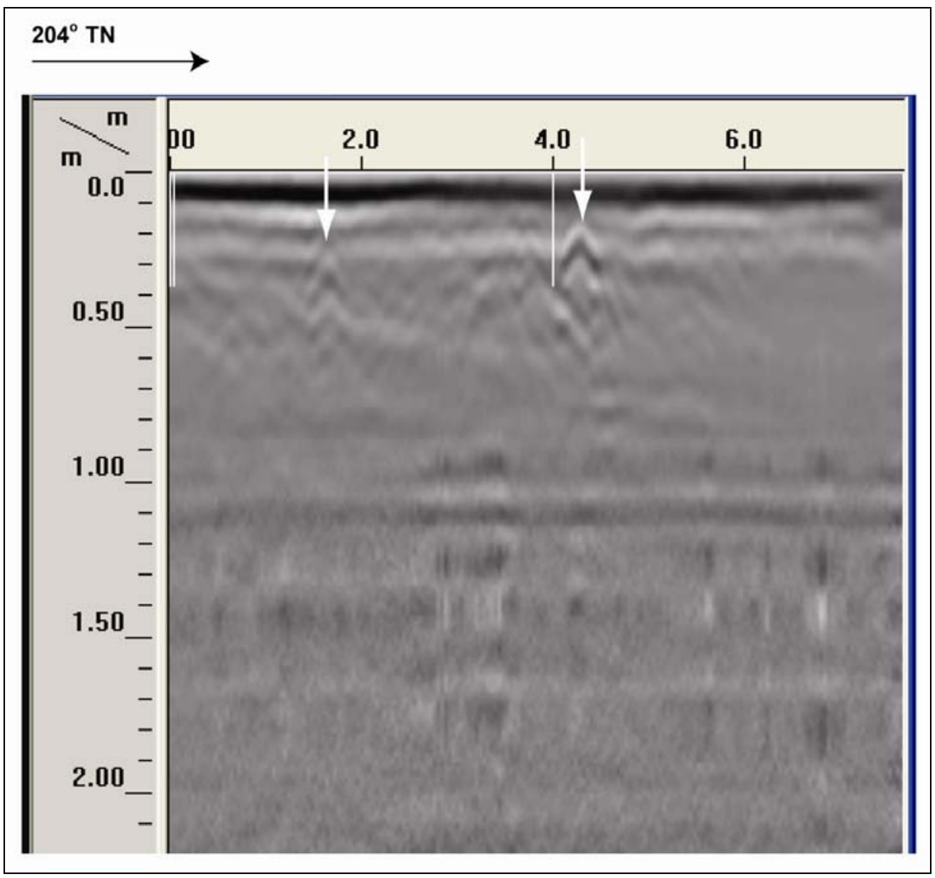

Figure 297. GPR profile of Pearl Highlands Station and P&R Test Trench 1

Pearl Highlands Station and P&R Test Trench 2

Orientation	106° TN
Length	6.5 m
Width	0.8 m
Maximum Depth	3.6 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 2.5 YR 4/4, reddish brown; silty clay loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Surface layer/topsoil for land parcel.
Ib	40-60	Fill Horizon; 10 YR 3/1, very dark gray; asphalt; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt smooth lower boundary; Asphalt/pavement fragments and gravel deposited as grading fill.
Ic	60-114	Fill Horizon; 2.5 YR 4/6, red; silt loam; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt smooth lower boundary; Terrigenous fill containing gravel (asphalt road?) debris.
Id	111-160	2.5 YR 4/3 reddish brown, reddish brown; clay loam; moderate, fine, crumb structure; weakly coherant dry consistency; friable moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Terrigenous alluvial clay fill; contains various types of debris--glass, basalt, basalt cobbles, pavement/concrete fragments.
Ie	160-323	Fill Horizon; 2.5 YR 2.5/4, dark reddish brown; clay loam; moderate, fine, crumb structure; friable moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; Terrigenous fill w/ basalt boulders.
II	323-367	Potential natural sediment; 10 R 2.5/1, reddish black; silt; strong, fine, crumb structure; friable moist consistency; non-sticky wet consistency; slightly plastic; no cementation; Possibly a natural sediment below the many fill layers. Sample taken from trench excavation at 340-367 cmbs.

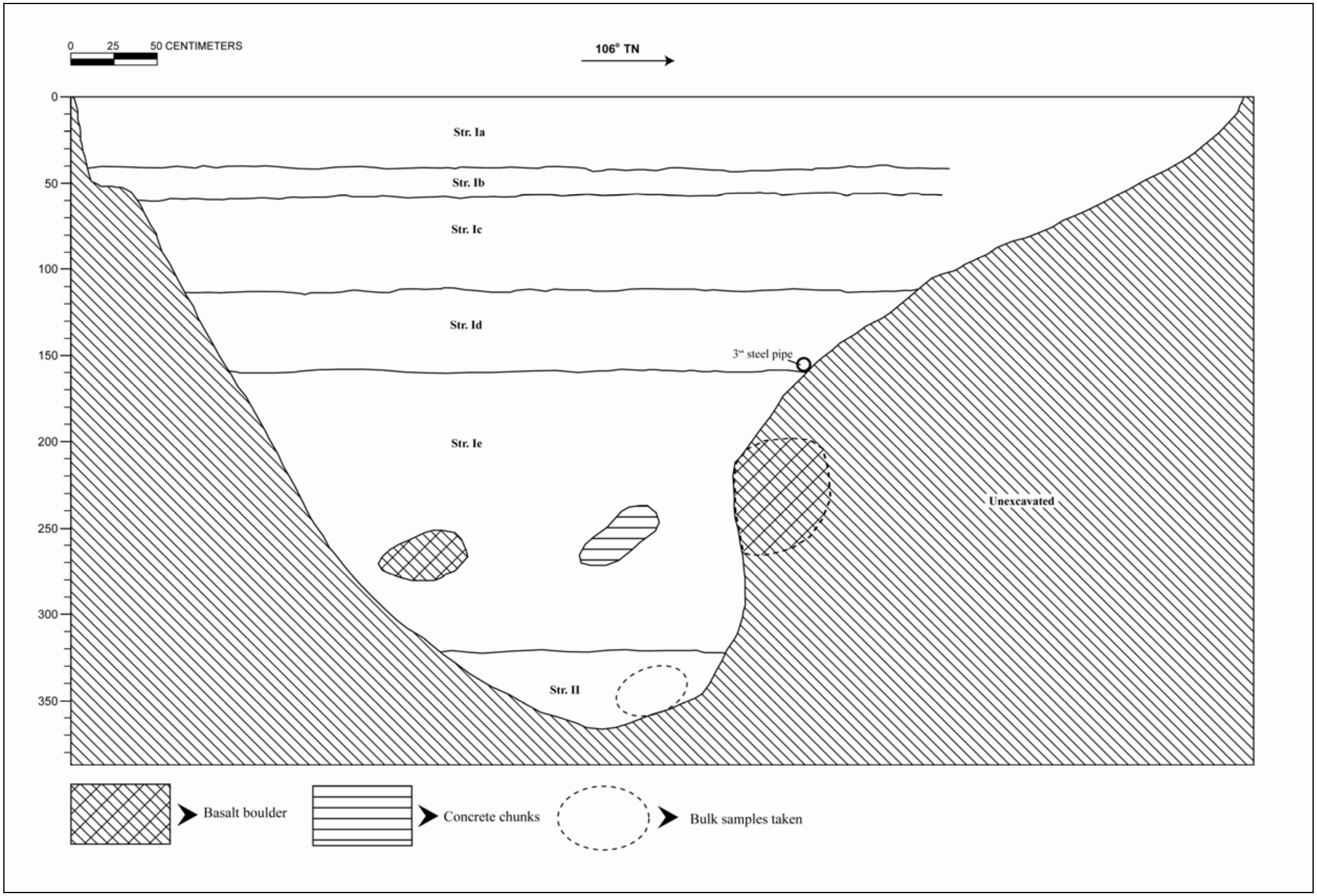

Figure 298. Profile of Pearl Highlands Station and P&R Test Trench 2

Figure 299. Photograph of Pearl Highlands Station and P&R Test Trench 2, view to north

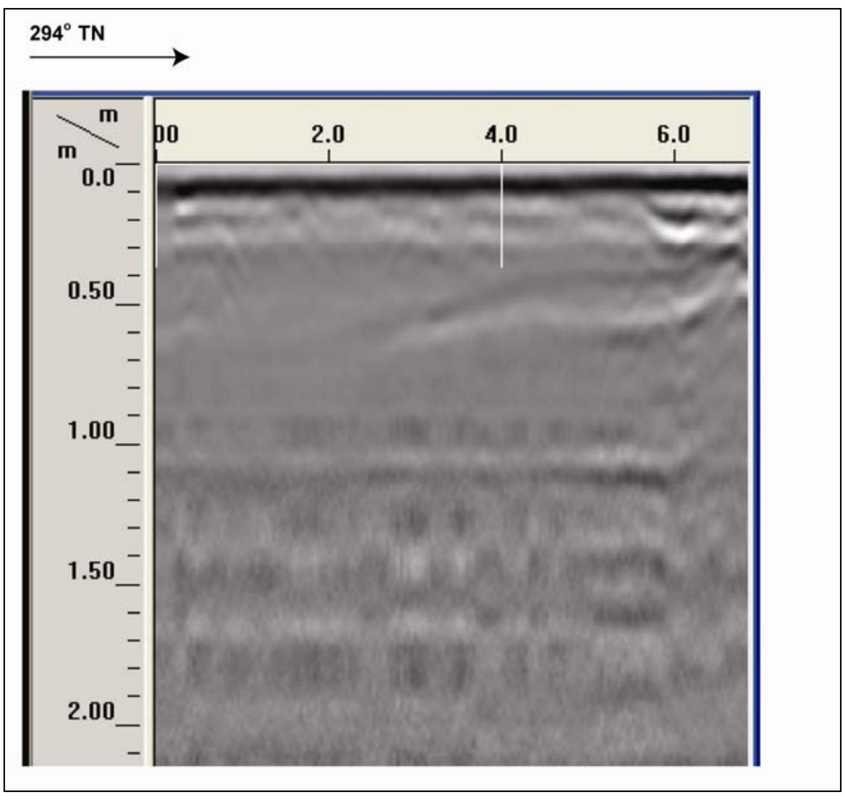

Figure 300. GPR profile of Pearl Highlands Station and P&R Test Trench 2

Pearl Highlands Station and P&R Test Trench 3

Orientation	293° TN
Length	6.5 m
Width	0.8 m
Maximum Depth	3.7 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill Horizon; 10 R 3/6, dark red; silty clay loam; moderate, fine, crumb structure; loose dry consistency; loose moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill.
Ib	30-51	Fill Horizon; 10 YR 3/1, very dark gray; asphalt; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt smooth lower boundary; Grading fill.
Ic	51-141	Fill Horizon; 5 YR 4/3, reddish brown; silt loam; structureless, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill.
Id	141-169	Fill Horizon; 10 YR 2/1, black; burnt debris; structureless, loose dry consistency; non-plastic; no cementation; diffuse smooth lower boundary; Grading fill, incinerated fill.
Ie	169-320	Fill Horizon; 7.5 YR 4/4, brown silty clay loam; moderate, fine, crumb structure; loose dry consistency; firm moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Terrigenous fill deposited by landowner >30 yrs ago as grading material.
II	320-370	Potential natural sediment; 10 YR 4/2, dark yellowish brown; clay; moderate, fine, crumb structure; very firm moist consistency; plastic; no cementation; possibly a natural alluvial sediment below the many fill layers..

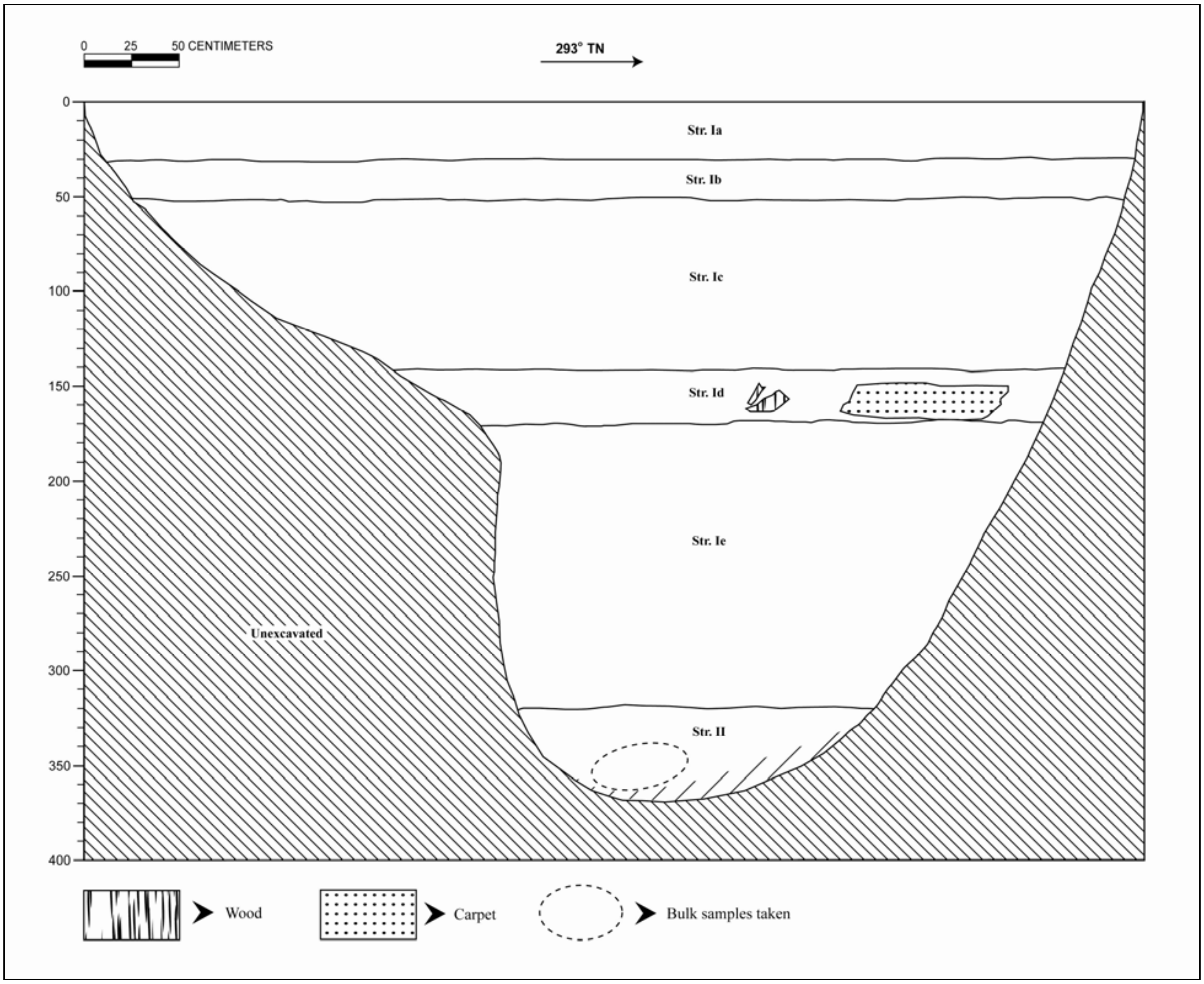

Figure 301. Profile of Pearl Highlands Station and P&R Test Trench 3

Figure 302. Photograph of Pearl Highlands Station and P&R Test Trench 3, view to south

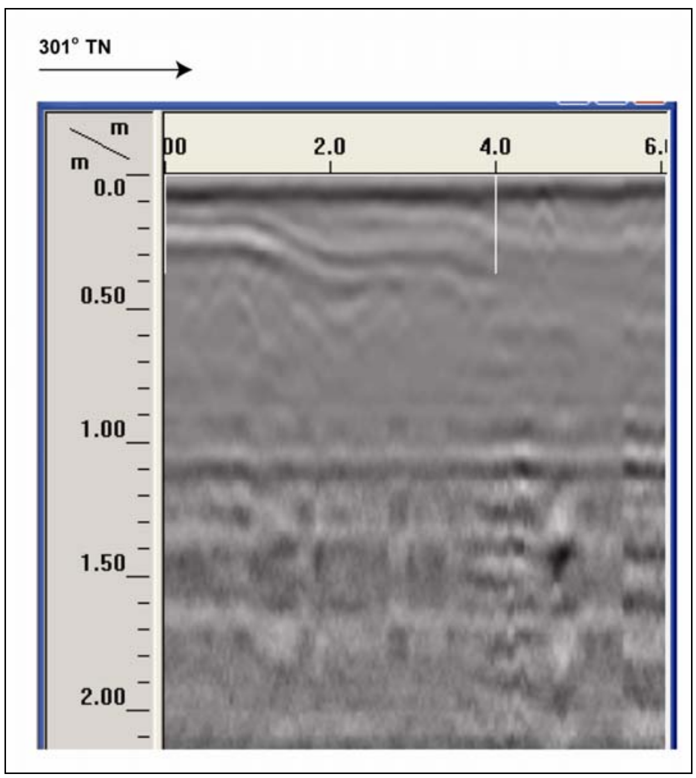

Figure 303. GPR profile of Pearl Highlands Station and P&R Test Trench 3

Pearl Highlands Station and P&R Test Trench 4

Orientation	300° TN
Length	6 m
Width	0.8 m
Maximum Depth	3.3 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 2.5 YR 3/3, dark reddish brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; abrupt wavy lower boundary; Backyard landscape surface.
Ib	40-65	Fill Horizon; 10 YR 3/2, very dark grayish brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Mixed fill.
Ic	65-110	Fill Horizon; 10 YR 4/3, brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; diffuse irregular lower boundary; Mixed fill.
Id	110-335	Fill Horizon; 10 YR 4/4, dark yellowish brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; Mixed fill.

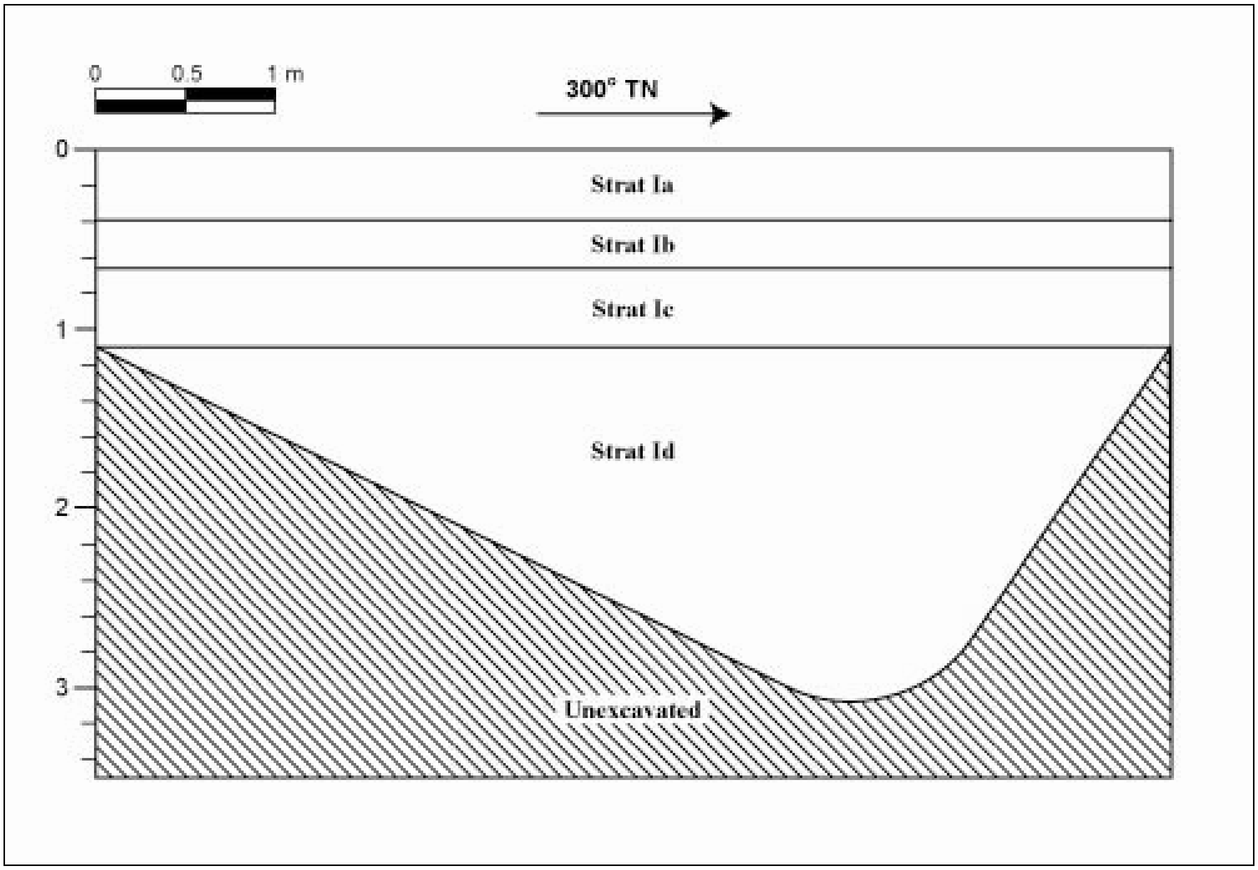

Figure 304. Profile of Pearl Highlands Station and P&R Test Trench 4

Figure 305. Photograph Pearl Highlands Station and P&R Test Trench 4, view to south

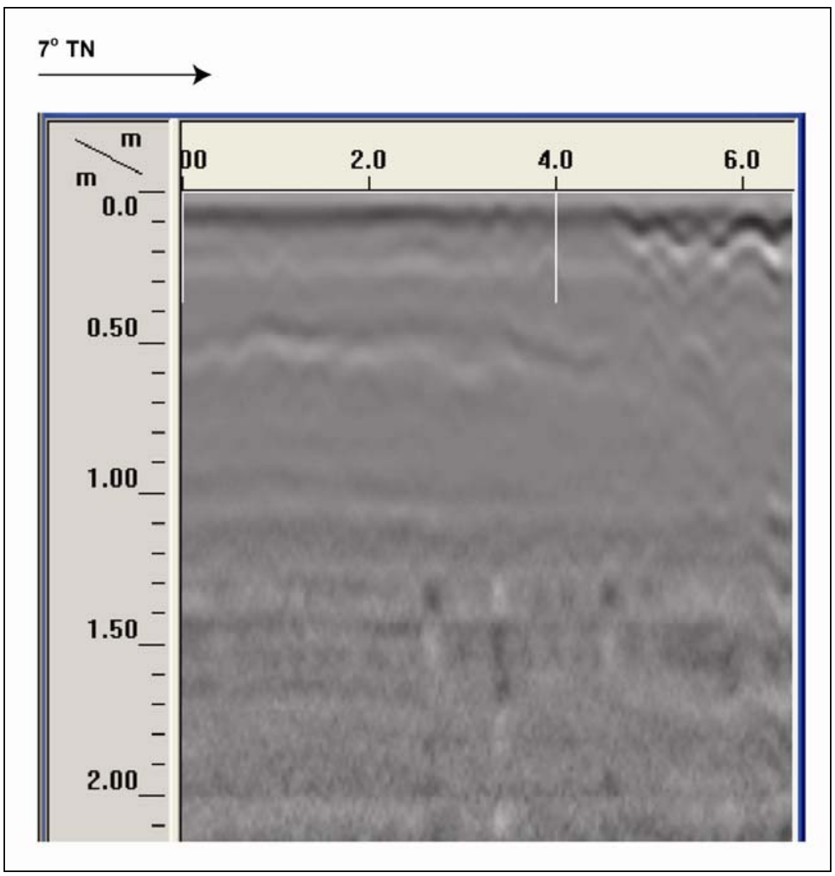

Figure 306. GPR profile of Pearl Highlands Station and P&R Test Trench 4

Pearl Highlands Station and P&R Test Trench 5

Orientation	003° TN
Length	6 m
Width	0.8 m
Maximum Depth	3.6 m

Stratum	Depth (cmbs)	Description
Ia	0-34	Fill Horizon; 10 R 3/4, dusky red; silty clay loam; weak, fine, crumb structure; slightly hard dry consistency; firm moist consistency; sticky wet consistency; plastic; no cementation; abrupt smooth lower boundary; Alluvial clay loam top soil for backyard surface.
Ib	34-65	Fill Horizon; 5 YR 5/3, reddish brown; silt; weak, fine, crumb structure; slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill containing gravel.
Ic	65-130	Fill Horizon; 2.5 YR 5/8, red; silt; weak, fine, crumb structure; hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Contains gravel.
Id	130-285	Fill Horizon; 7.5 YR 5/3, brown; silt; structureless, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Contains gravel, crushed coral and basalt.
Ie	285-367	Fill Horizon; 10 YR 4/3, brown; silt; structureless, loose dry consistency; non-plastic; no cementation; Landfill material containing various debris including asfault and concrete fragments, coral, bricks and basalt cobbles.

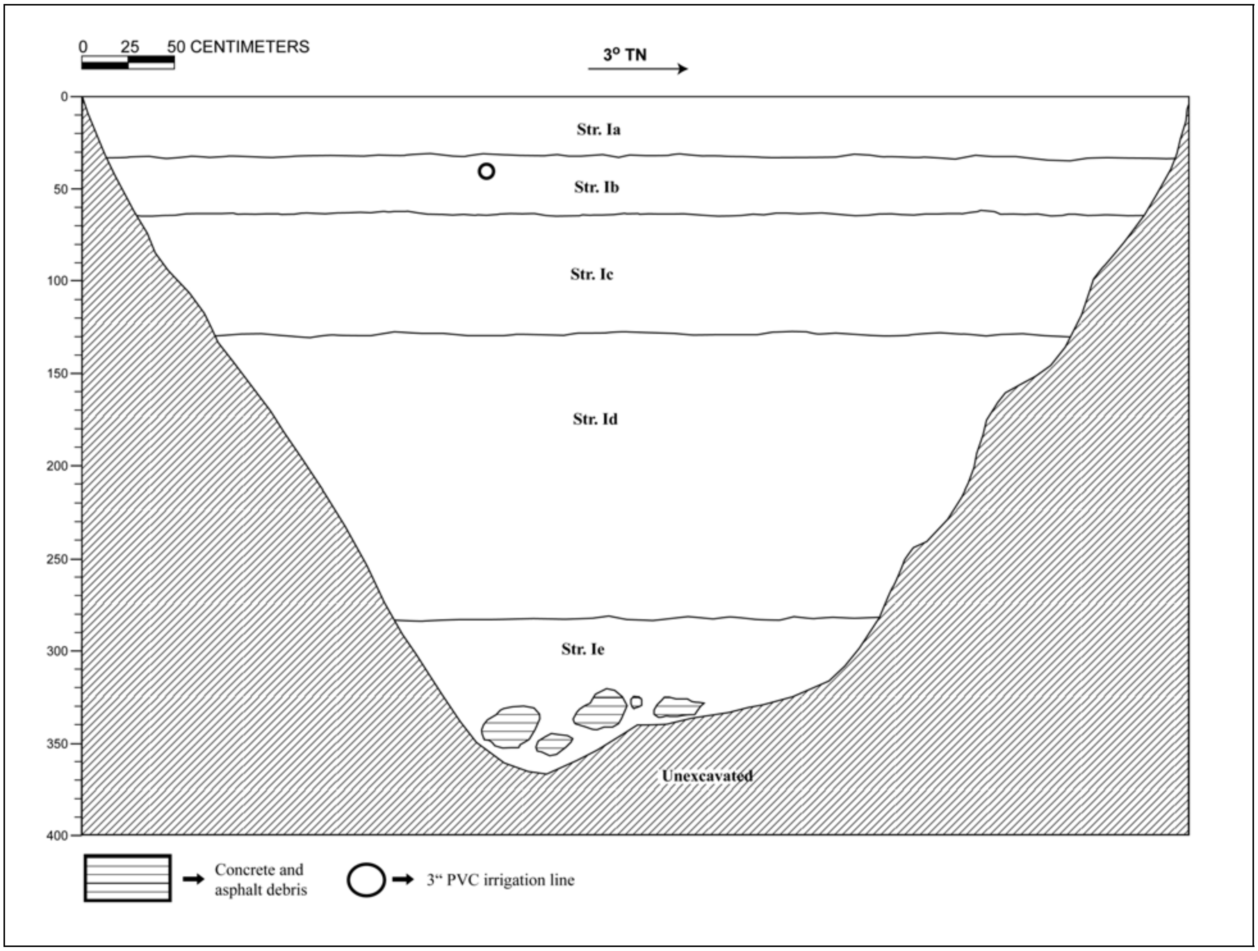

Figure 307. Profile of Pearl Highlands Station and P&R Test Trench 5

Figure 308. Photograph of Pearl Highlands Station and P&R Test Trench 5, view to west

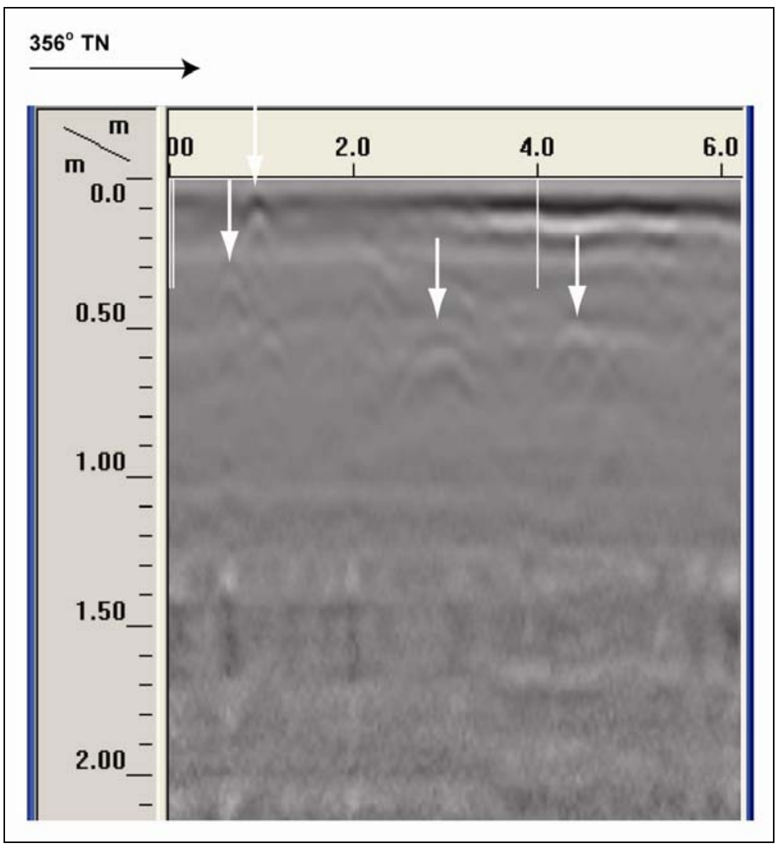

Figure 309. GPR profile of Pearl Highlands Station and P&R Test Trench 5

Pearl Highlands Station and P&R Test Trench 6

Orientation	192° TN
Length	6 m
Width	0.8 m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill Horizon; 10 YR 4/4, dark yellowish brown; silt; structureless, loose dry consistency; non-plastic; no cementation; abrupt broken lower boundary; Driveway surface.
Ib	25-60	Fill Horizon; 7.5 YR 3/3, dark brown; silt loam; structureless, weakly coherant dry consistency; friable moist consistency; no cementation; diffuse broken lower boundary; Mixed fill.
Ic	60-100	Fill Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, loose dry consistency; non-plastic; no cementation; diffuse irregular lower boundary; Const. material fill.
Id	100-160	Fill Horizon; 10 YR 4/3, brown; silt loam; structureless, weakly coherant dry consistency; non-plastic; no cementation; Mixed fill.

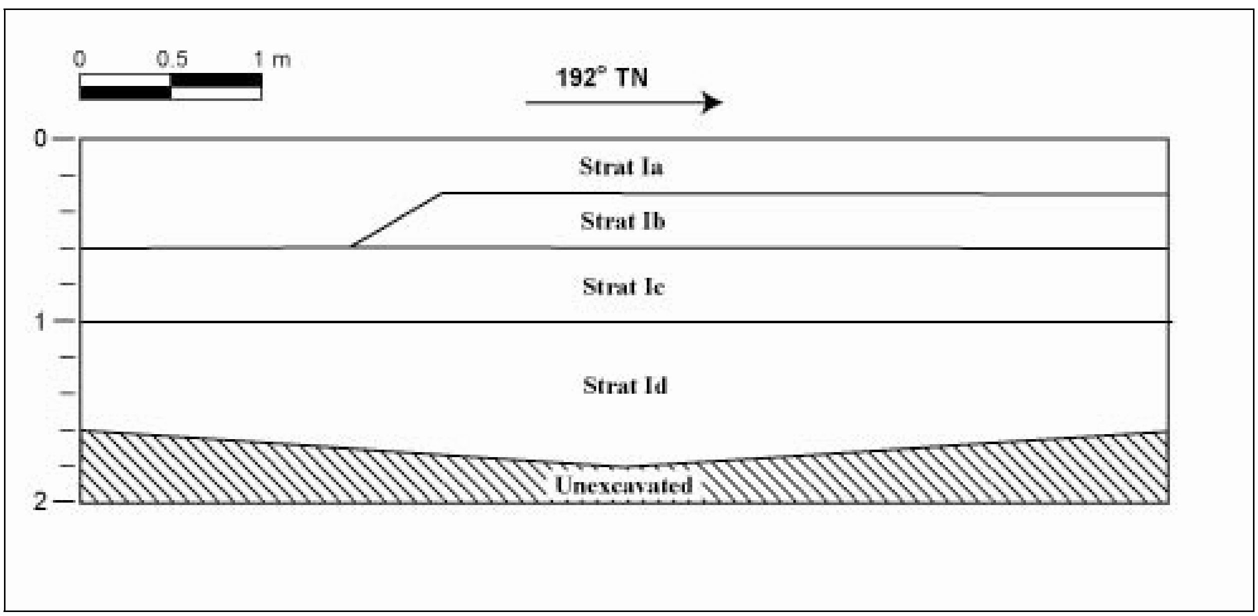

Figure 310. Profile of Pearl Highlands Station and P&R Test Trench 6

Figure 311. Photograph of Pearl Highlands Station and P&R Test Trench 6, view to east

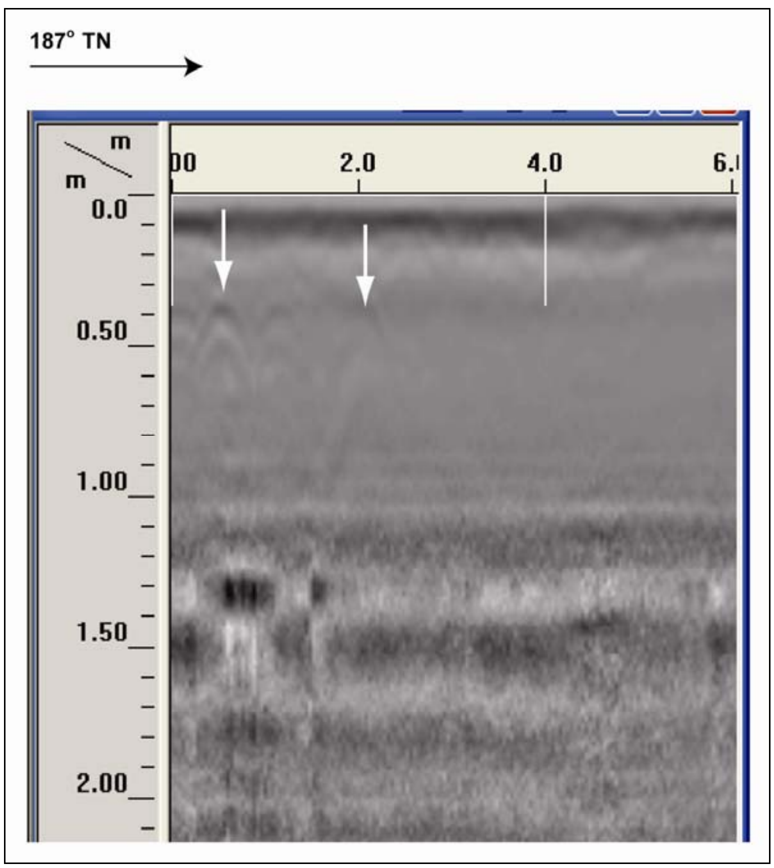

Figure 312. GPR profile of Pearl Highlands Station and P&R Test Trench 6

Pearl Highlands Station and P&R Test Trench 7

Orientation	88° TN
Length	5.5m
Width	0.7m
Maximum Depth	210m

Stratum	Depth (cmbs)	Description
Ia	0-10	Gravel Fill
Ib	10-30	Fill Horizon; 5 YR 3/4, dark reddish brown; clay; strong medium blocky structure; dry very hard consistency; plastic; no cementation; abrupt smooth lower boundary; imported fill
Ic	30-50	Fill Horizon; 5 YR 4/6 yellowish red; clay; moderate medium blocky structure; dry very hard consistency; plastic; no cementation; terrestrial origin; abrupt broken lower boundary; imported construction fill
Id	30-140	Fill Horizon; 5 YR 3/2 dark reddish brown; silty clay loam; moderate medium crumb structure; dry slightly hard consistency; slightly plastic; weak cementation; terrestrial origin; abrupt smooth lower boundary
Ie	140-210	Fill Horizon; 7.5 YR 5/3 silt loam; weak fine crumb structure; dry weakly coherent consistency; non-plastic; weak cementation; terrestrial origin; imported construction fill

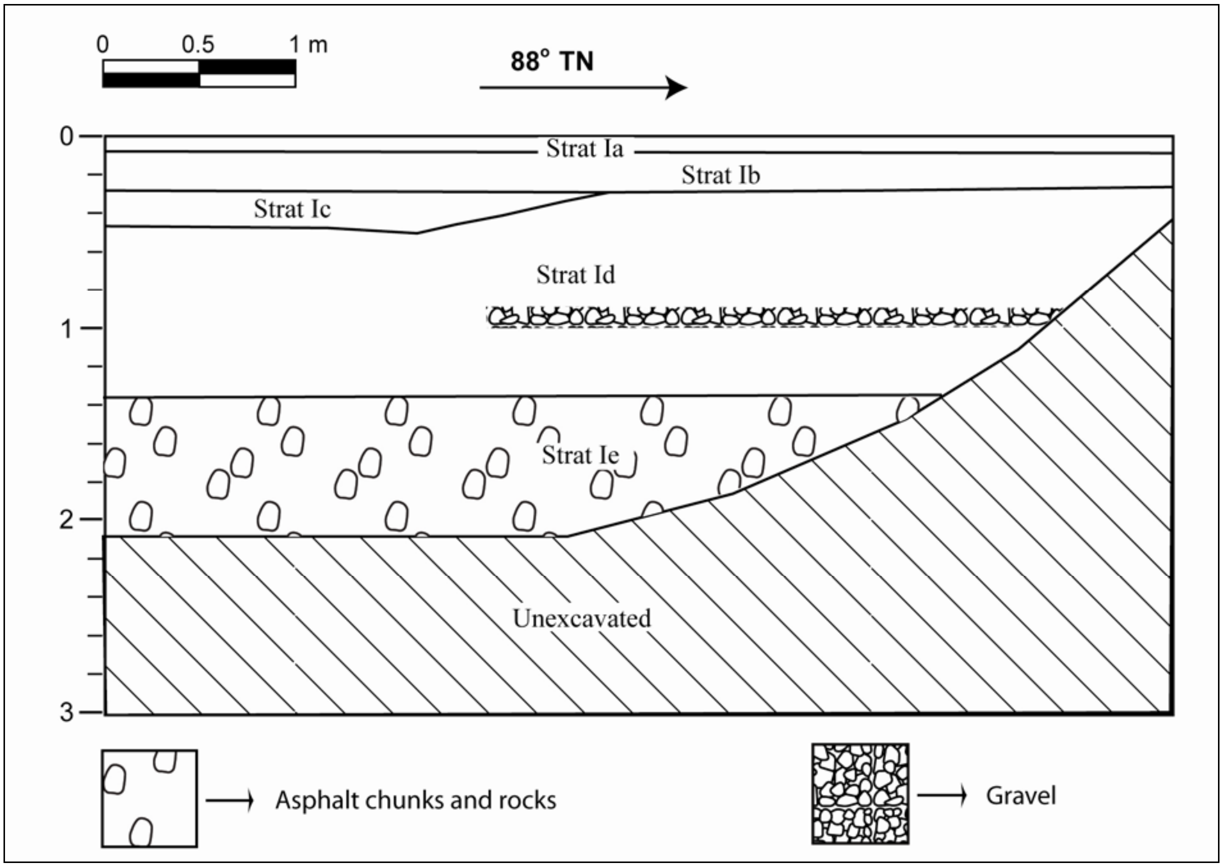

Figure 313. Profile of Pearl Highlands Station and P&R Test Trench 7

Figure 314. Photograph of Pearl Highlands Station and P&R Test Trench 7, view to north

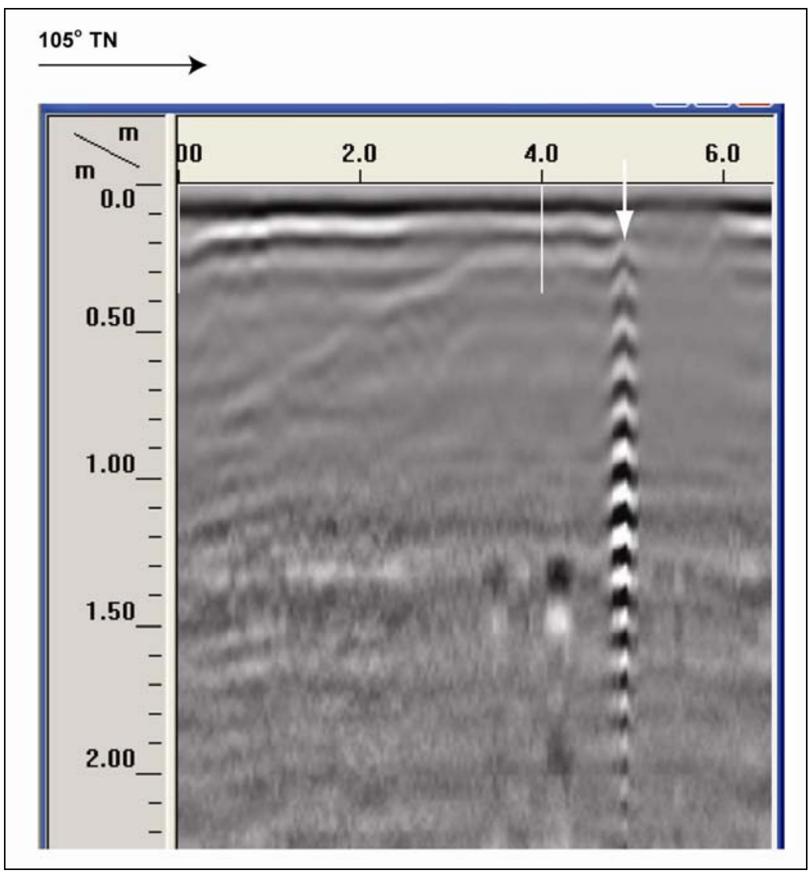

Figure 315. GPR profile of Pearl Highlands Station and P&R Test Trench 7

GPR profile of Pearl Highlands Station and P&R Test Trench 8

Orientation	115° TN
Length	8m
Width	0.7m
Maximum Depth	2.6m

Stratum	Depth (cmbs)	Description
Ia	0-20	Fill Horizon; 10 YR 5/2, very pale brown; crushed coral; structurless; dry loose consistency; non-plastic; no cementation; marine origin; very abrupt smooth lower boundary, contained some modern trash
Ib	20-130	Fill Horizon; 5 YR 2.5/2 dark reddish brown; clay loam; structurless; moist very firm consistency; plastic; no cementation; terrestrial origin;

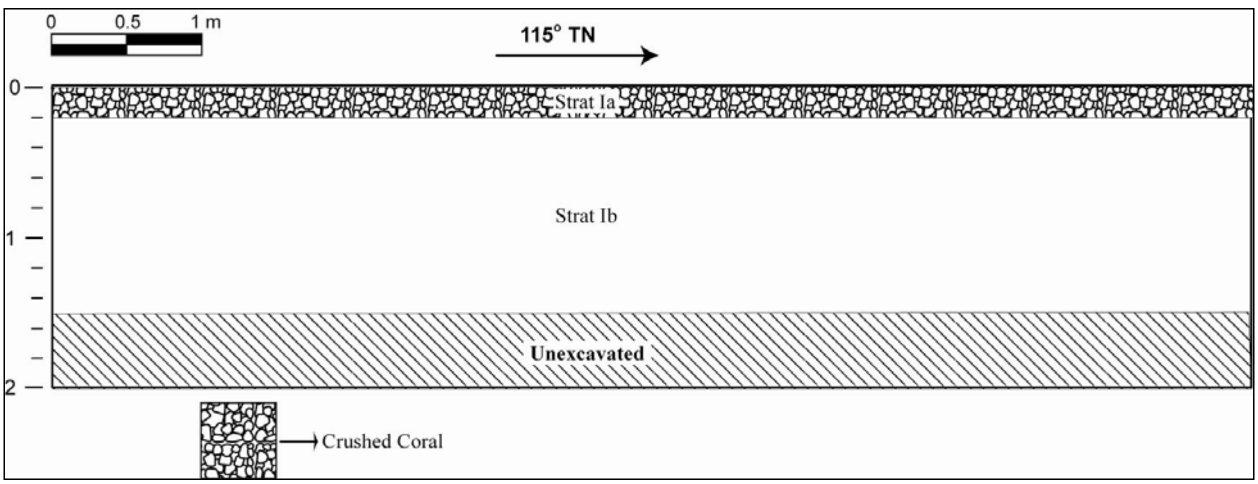

Figure 316. Profile of Pearl Highlands Station and P&R Test Trench 8

Figure 317. Photograph of Pearl Highlands Station and P&R Test Trench 8, view to northwest

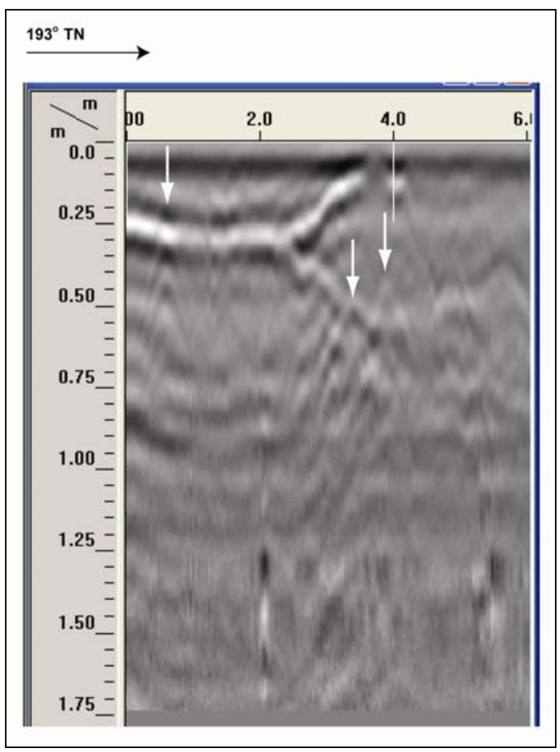

Figure 318. GPR profile of Pearl Highlands Station and P&R Test Trench 8

Pearl Highlands Station and P&R Test Trench 9

Orientation	20° TN
Length	6 m
Width	0.7 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 2.5 YR 2.5/2, dark reddish brown; silty clay loam; structurless; moist very friable consistency; non-plastic; no cementation; terrestrial; clear irregular lower boundary; contains modern trash
Ib	40-270	Fill Horizon; 7.5 YR 3/3 dark brown; clay loam; structurless; moist very firm consistency to wet very sticky consistency; very plastic; no cementation; terrestrial origin, contains basalt boulders modern trash crushed coral concrete and gravel

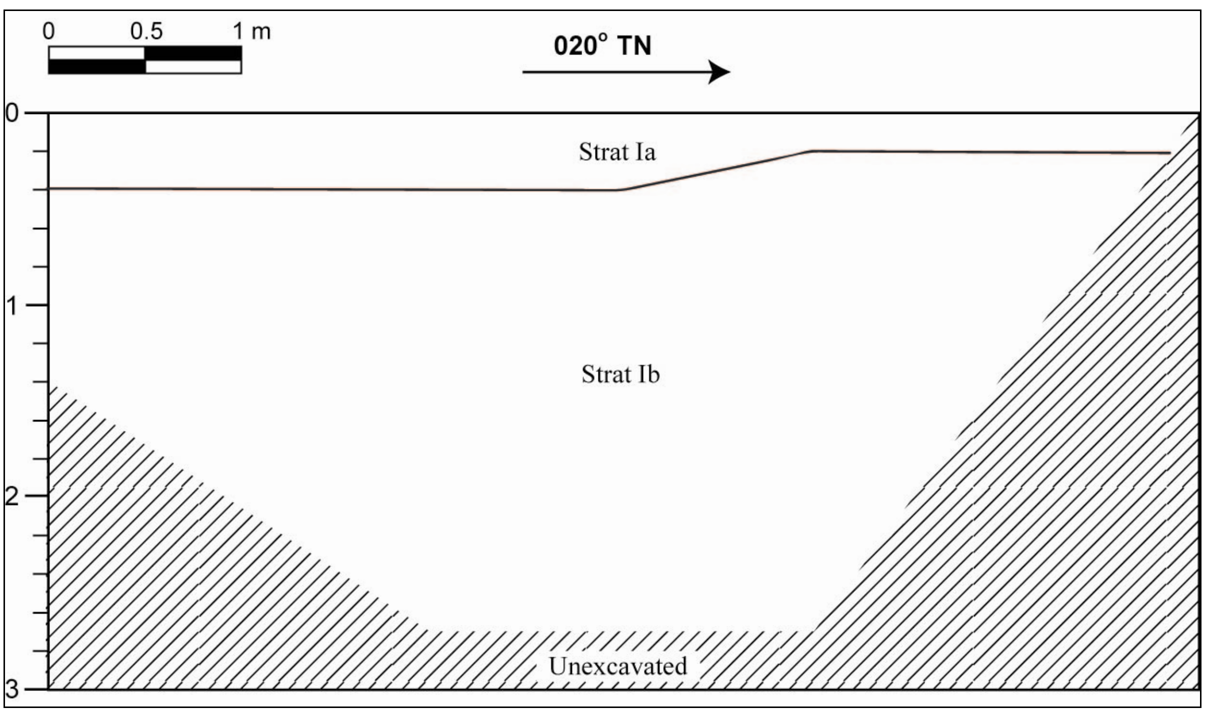

Figure 319. Profile of Pearl Highlands Station and P&R Test Trench 9

Figure 320. Photograph of Pearl Highlands Station and P&R Test Trench 9, view to west

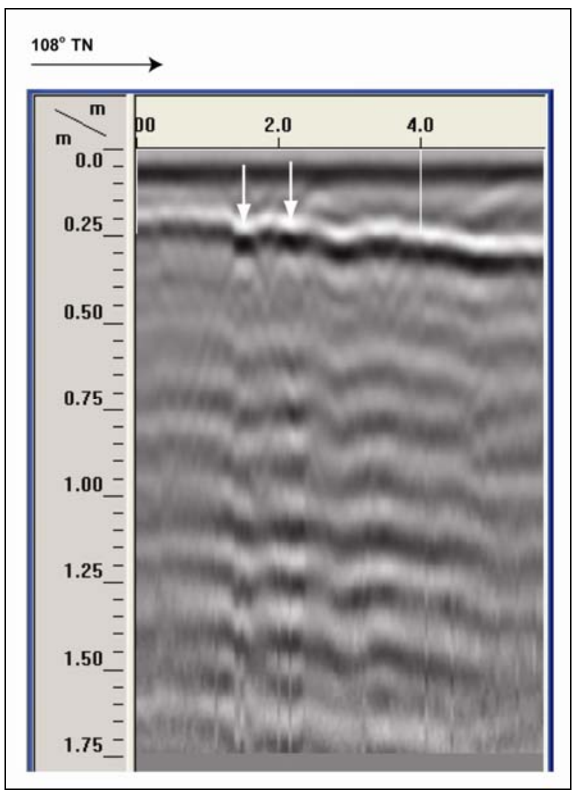

Figure 321. GPR profile of Pearl Highlands Station and P&R Test Trench 9

Pearl Highlands Station and P&R Test Trench 10

Orientation	20° TN
Length	5 m
Width	0.7 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-60	Fill Horizon; 10 YR 4/2, dark grayish brown; silty sandy loam; structurless; dry loose consistency; non-plastic; no cementation; mixed origin; clear irregular lower boundary; contains modern trash, rebar, metal coral, basalt gravel and roots
Ib	60-120	Fill Horizon; 5 YR 3/3 dark reddish brown; clay loam; structurless; dry loose consistency; non plastic; no cementation; mixed origins; clear irregular lower boundary; contains rebar and modern trash
Ic	120-250	Fill Horizon; 10 YR 3/4, dark yellowish brown; silty clay loam; structurless; very friable moist consistency; slightly plastic; no cementation; mixed origin; contains modern trash, rebar, tile, coral and concrete

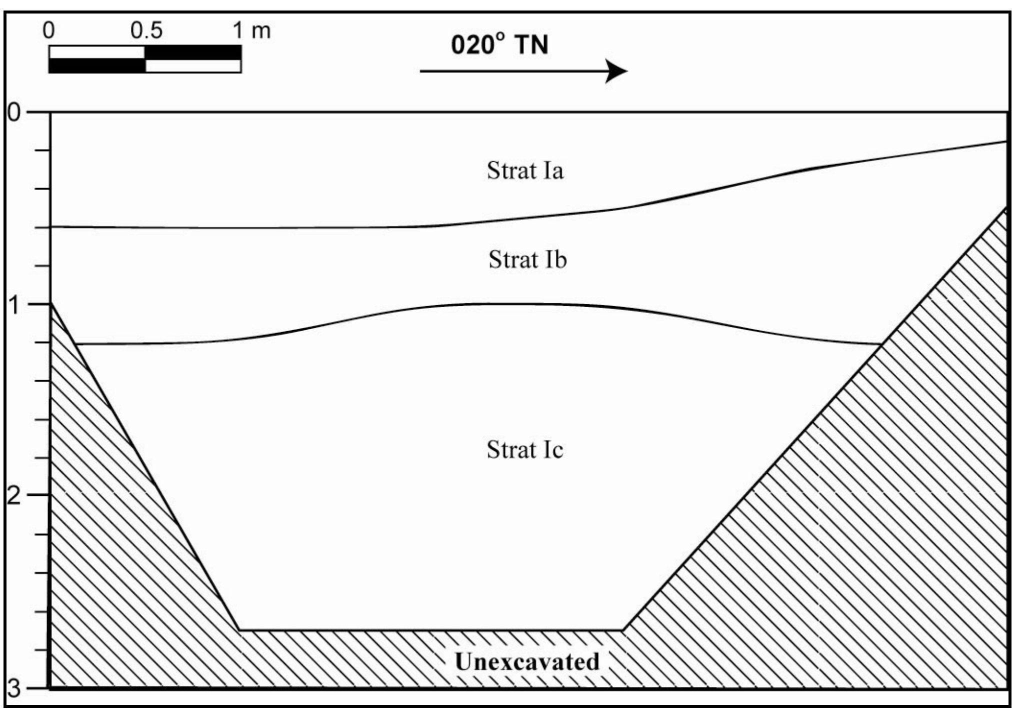

Figure 322. Profile of Pearl Highlands Station and P&R Test Trench 10

Figure 323. Photograph of Pearl Highlands Station and P&R Test Trench 10, view to west

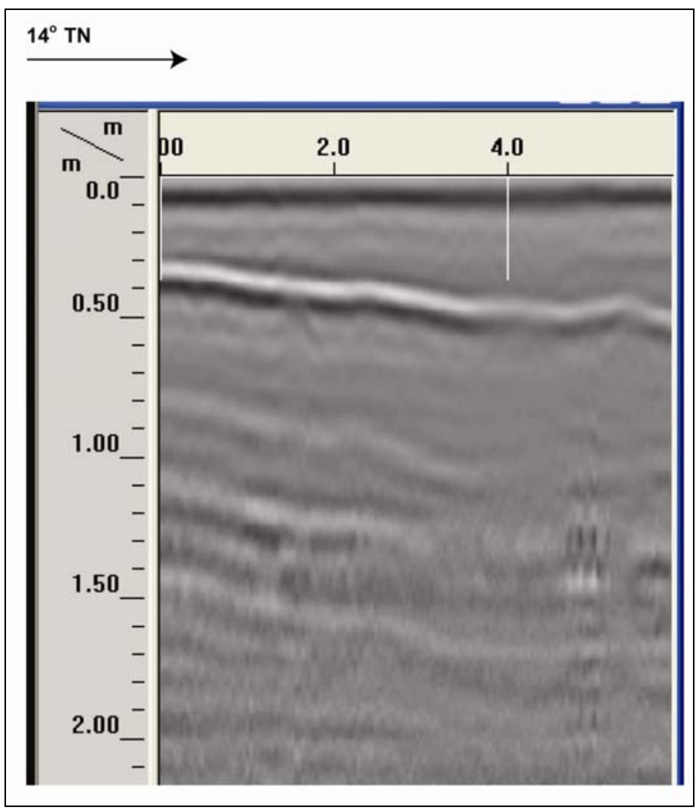

Figure 324. GPR profile of Pearl Highlands Station and P&R Test Trench 10

Pearl Highlands Station and P&R Test Trench 11

Orientation	174° TN
Length	5 m
Width	0.7 m
Maximum Depth	2.4 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Fill Horizon; 7.5 YR 4/1, dark gray; silt loam; weak fine single grain structure; dry weakly coherent consistency; non-plastic; weak cementation; terrestrial; abrupt smooth lower boundary
Ib	50-90	Fill Horizon; 5 YR ¾, dark reddish brown; moderate fine blocky structure; dry hard consistency; plastic; no cementation; terrestrial; abrupt smooth lower boundary
Ic	90-240	Fill Horizon; 5 YR 2.5/2 dark reddish brown; silt loam; weak medium granular structure; dry loose consistency; non-plastic; no cementation; terrestrial origin, contains asphalt, cement blocks and trash

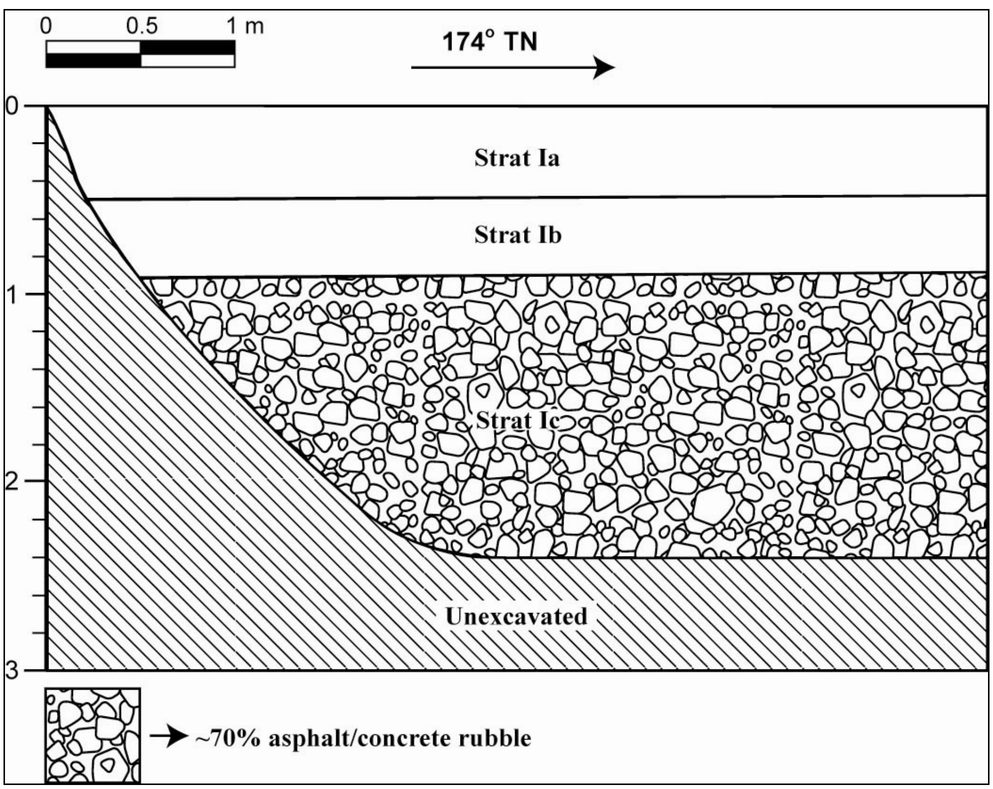

Figure 325. Profile of Pearl Highlands Station and P&R Test Trench 11

Figure 326. Photograph of Pearl Highlands Station and P&R Test Trench 11, view to east

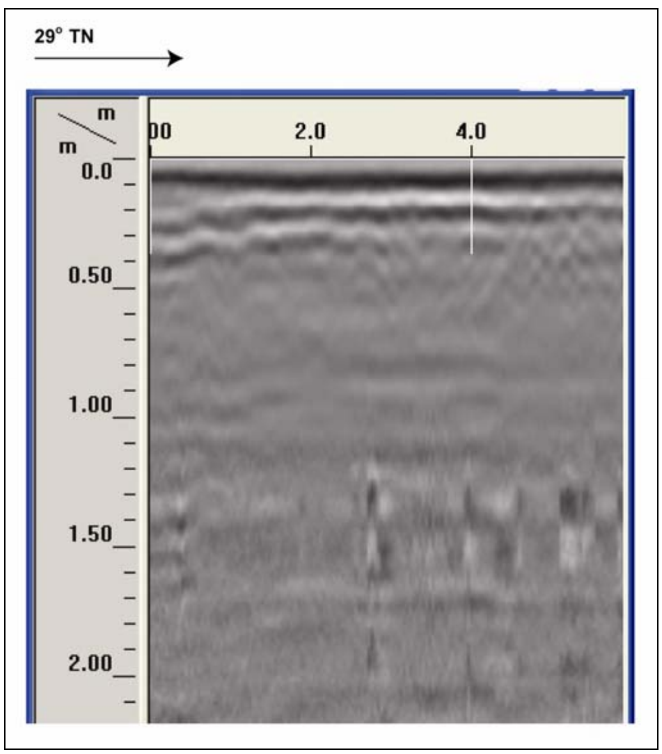

Figure 327. GPR profile of Pearl Highlands Station and P&R Test Trench 11

Column Test 32 (C-32)

Orientation	088° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill; 7.5 YR 2.5/3, very dark brown; silty clay loam; weak, medium, crumb structure; weakly coherant dry consistency; slightly plastic; weak cementation; abrupt smooth lower boundary; imported fill associated with prior land grading.
Ib	40-250	Fill; 2.5 YR 2.5/4, dark reddish brown; clay loam; moderate, medium, crumb structure; slightly hard dry consistency; plastic; no cementation; disturbed sediment associated with modern land filling.

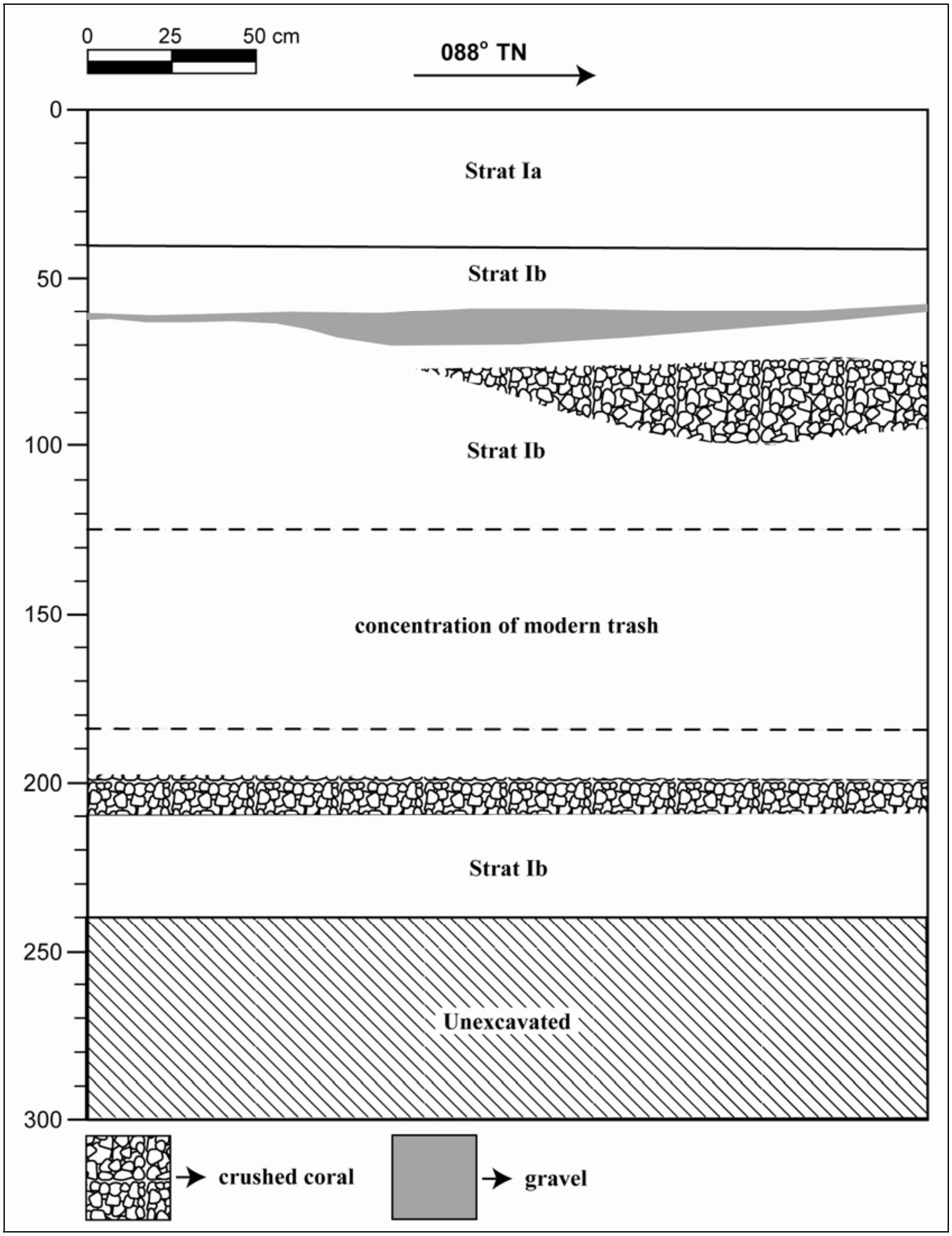

Figure 328. Profile of Column Test 32 (C-32)

Figure 329. Photograph of Column Test 32 (C-32), view to north

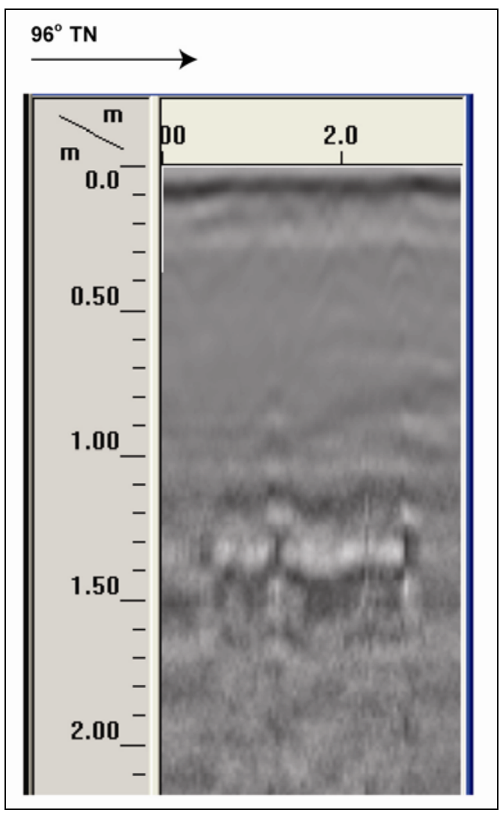

Figure 330. GPR profile of Column Test 32 (C-32)

Column Test 33 (C-33)

Orientation	086° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Fill; 7.5 YR 2.5/3, very dark brown; silty loam; weak, fine, grandular structure; weakly coherant dry consistency; non plastic; weak cementation; abrupt smooth lower boundary; imported fill associated with prior land grading.
Ib	10-40	Fill; 5 YR 3/4, dark reddish brown; clay; moderate, medium, blocky structure; hard dry consistency; plastic; no cementation; abrupt smooth lower boundary;
Ic	40-110	Fill; 7.5 YR 4/6, strong brown; clay; moderate, medium, blocky structure; hard dry consistency; plastic; no cementation; abrupt smooth lower boundary;
Id	110-200	Fill; 5 YR 2.5/2, dark reddish brown; silt loam; weak, fine, granular structure; weakly coherant dry consistency; non-plastic; weak cementation; small amount of modern trash - rebar

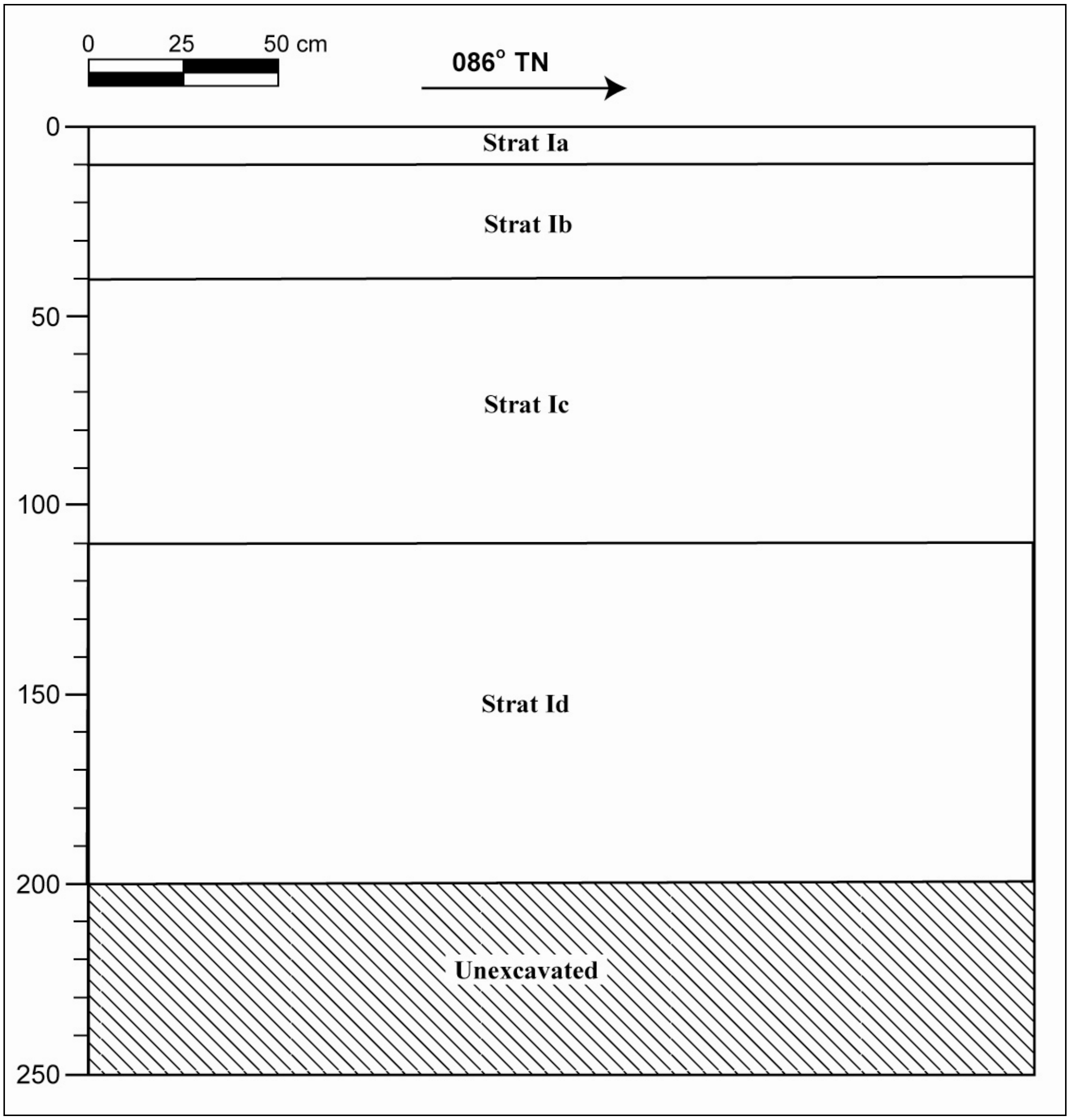

Figure 331. Profile of Column Test 33 (C-33)

Figure 332. Photograph of Column Test 33 (C-33), view to north

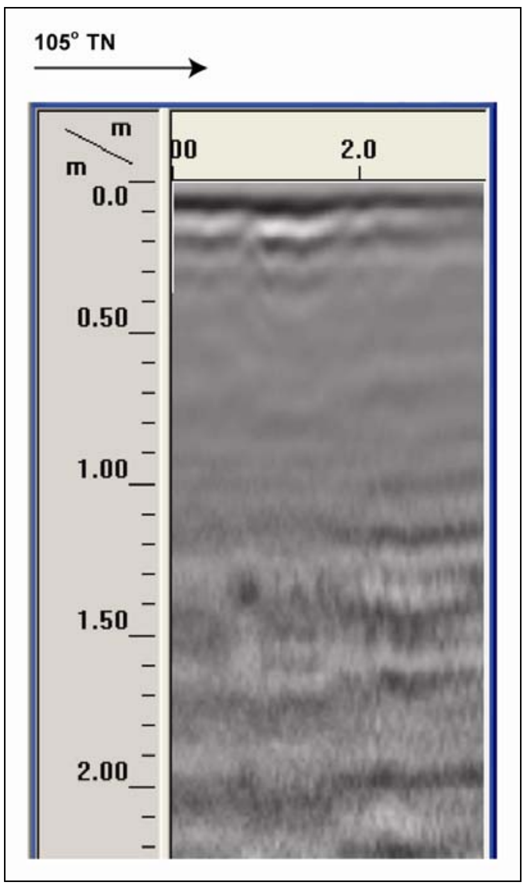

Figure 333. GPR profile of Column Test 33 (C-33)

Column Test 34 (C-34)

Orientation	070° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
I	0-190	Fill Horizon; 10 YR 3/3, dark brown; silty clay loam; structureless, weakly coherant dry consistency; friable moist consistency; slightly plastic; no cementation; diffuse irregular lower boundary; modern fill, possibly dozer push to build up stream bank
II	190-260	10 YR 3/2, very dark grayish brown; clay; moderate, fine, crumb structure; very sticky wet consistency; very plastic; no cementation; alluvial sediment excavated at water table

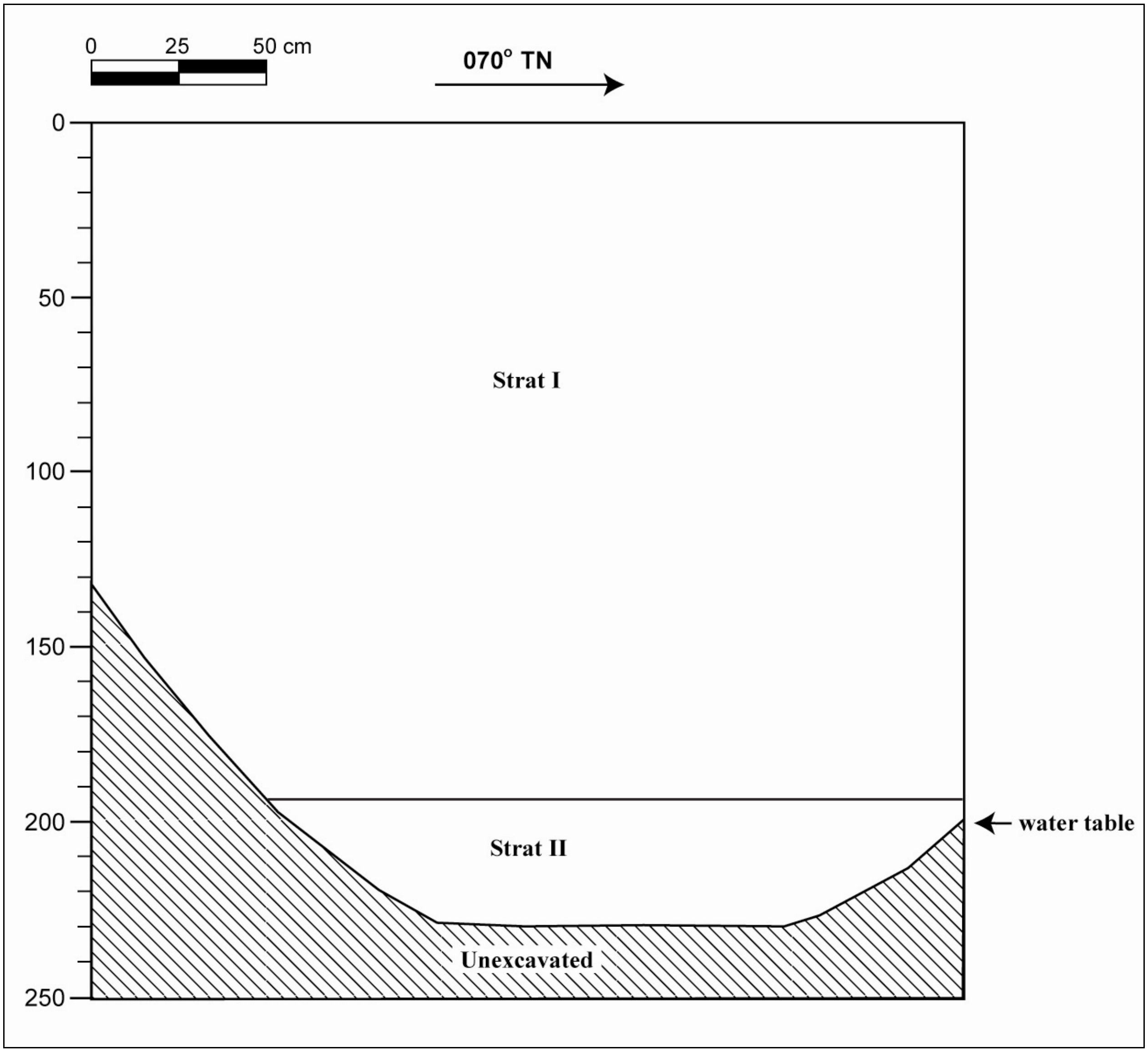

Figure 334. Profile of Column Test 34 (C-34)

Figure 335. Photograph of Column Test 34 (C-34), view to north

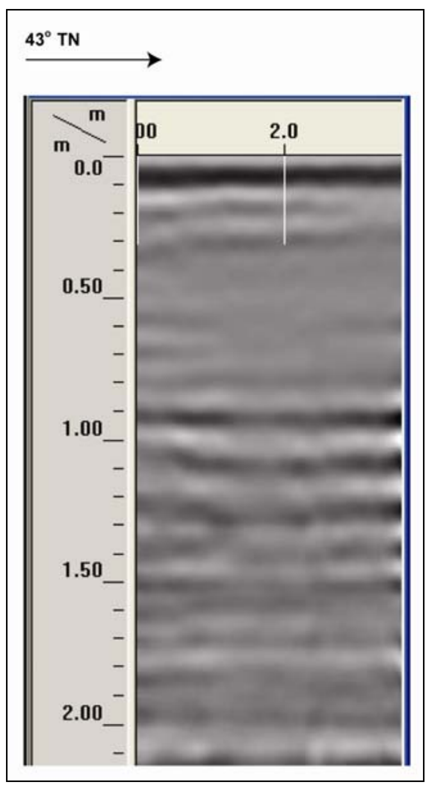

Figure 336. GPR profile of Column Test 34 (C-34)

Column Test 35 (C-35)

Orientation	120° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.2 m

Stratum	Depth (cmbs)	Description
I	0-220	2.5 YR 4/6, red; silty clay loam; loose, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Naturally deposited sediment. Top 140 cm was previously disturbed due to subsurface utilities. Construction debris observed: gravel, basalt cobbles, mesh screen, concrete/asphalt, pieces oc lumber, plastics.

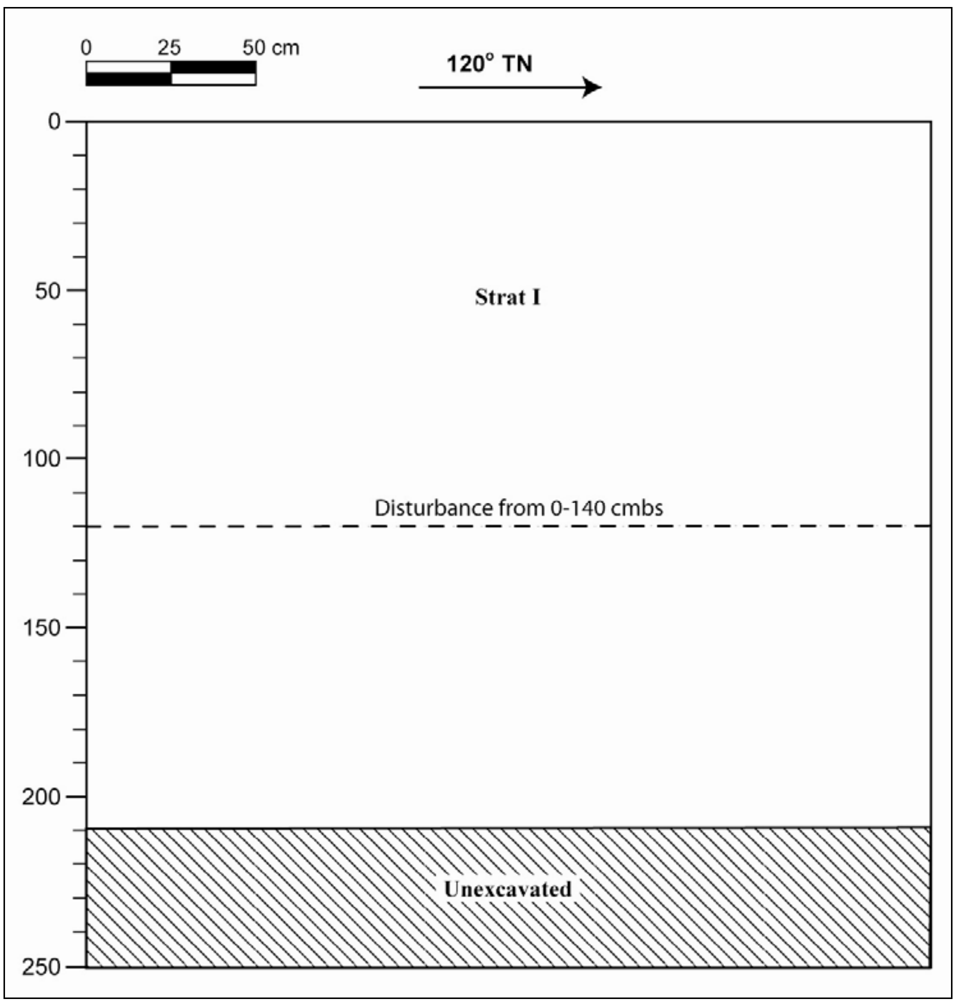

Figure 337. Profile of Column Test 35 (C-35)

Figure 338. Photograph of Column Test 35 (C-35), view to north

Column Test 36 (C-36)

Orientation	091° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.8 m

Stratum	Depth (cmbs)	Description
Ia	0-60	Fill; 2.5 YR 4/6, red; gravel, silty clay loam; loose, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; grading fill containing domestic and construction debris - gravel, basalt cobbles, mesh screen, concrete/asphalt, pieces oc lumber, plastics, rubber, exotic/wild grasses and brush growing about area
Ib	60-75	10 YR 8/2, very pale brown; coral, silty clay loam; structureless, loose, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; crushed coral fill mottled with strat Ia - cap for terrigenous fill layer below
Ic	75-280	Fill; 10 YR 5/3, brown; silt loam; weak, fine, crumb structure; loose, slightly hard dry consistency; non-plastic; no cementation; terrigenous fill containing sm - med cobbles, basalt boulders, concrete fragments

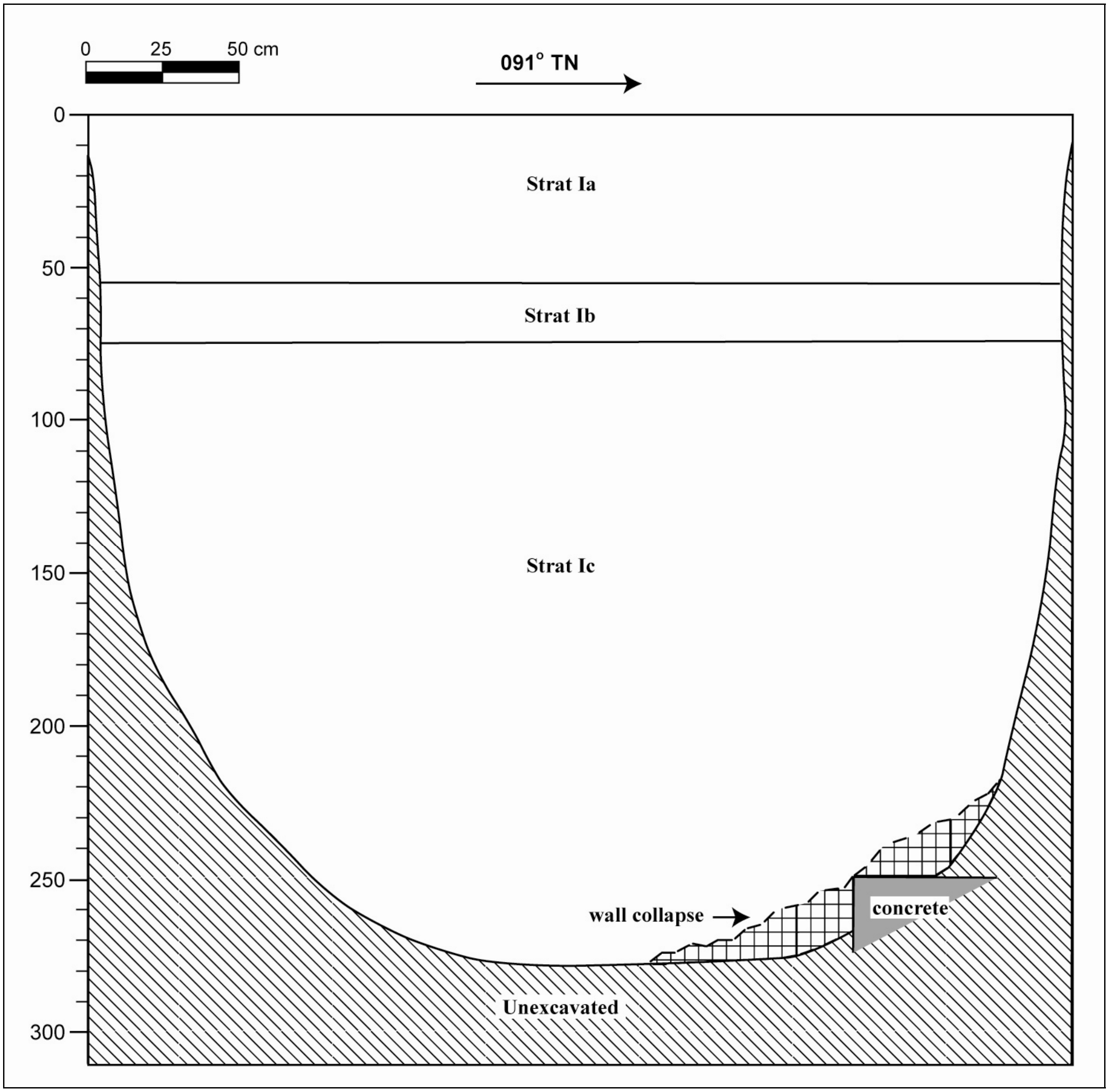

Figure 339. Profile of Column Test 36 (C-36)

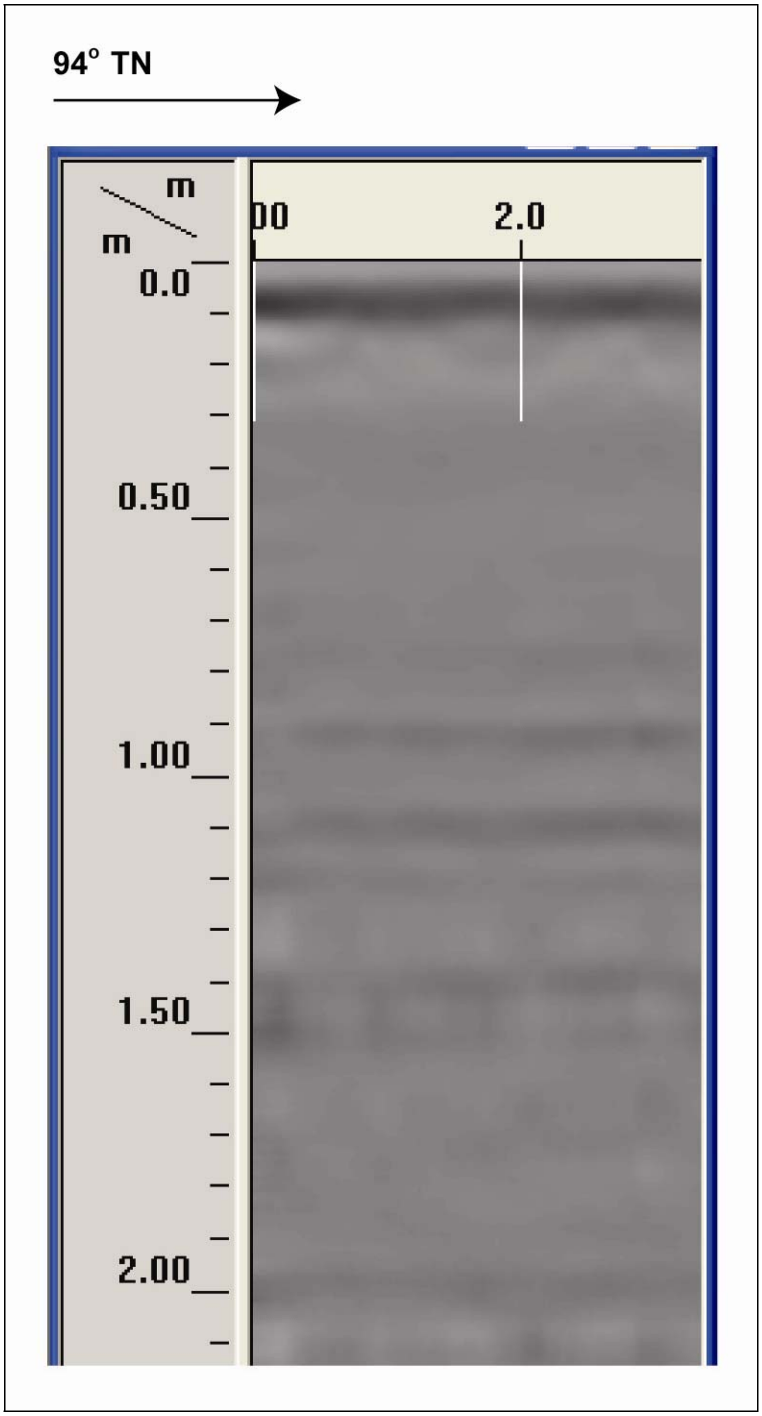

Figure 340. GPR profile of Column Test 36 (C-36)

4.15 Construction Sheet RW016

Construction Sheet RW016 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor (Figure 341). Two column test pits (C-30 & C-31) were excavated within the area delineated by Construction Sheet RW016.

4.15.1 Pedestrian Inspection

As the transit route enters the Pearl City area, it is re-routed to follow the path of Kamehameha Highway, proceeding east towards Honolulu. The surrounding area consists of the lower industrial section of Pearl City, along with several outlet stores (Home Depot, Sam's Club, etc.), a school, a post office, and several small businesses (Figure 342). As with the route through Waipahu, the transit line is situated along the middle of the roadway. However the median strip down Kamehameha highway is drastically different as there is little to no landscaping, being replaced with signs, utilities, and fencing. Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.15.2 GPR Survey

Prior to excavation all test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey was able to define the stratigraphic interfaces within the top 25 to 50 cm of all test areas. The subtle horizontal banding shown from approximately 0 to 50 cmbs in the GPR profiles seems to correspond to asphalt surfaces and their underlying crushed coral base course (see Figure 343 thru Figure 348). It is believed that the variance in consistency and compaction between the asphalt and coral base course, and the underlying sediments allowed the GPR to delineate the stratigraphic interface between them. However, as with the entire study area, radar penetration was limited to an approximate depth of 1 m.

GPR was also able to detect subsurface anomalies at column test C-30 (Figure 345). These anomalies likely corresponded to cobbles noted during test excavation.

Figure 341. Construction Sheet RW016 showing the location of test excavations

Figure 342. Photograph of transit route (view to northwest) as it enters lower industrial section of Pearl City following Kamehameha Highway

4.15.3 Subsurface Testing

4.15.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW016 (see Figure 341). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 295 to Figure 340).

In general, the observed and documented stratigraphy consisted of varying layers of fill overlying naturally deposited alluvial sediment. All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.15.3.2 Excavation Documentation

Column Test 30 (C-30)

Orientation	108° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.8 m

Stratum	**Depth (cmbs)**	**Description**
Ia	0-20	Asphalt
Ib	20-40	Crushed coral fill
Ic	40-60	Fill; 2.5 YR 3/6, dark red; silty clay loam; moderate, fine, crumb structure; loose dry consistency; firm moist consistency; non-plastic; no cementation; Alluvial silty clay loam fill deposited during development of area - contains gravel, cinder, small cobbles.
Id	60-70	Fill; 10 YR 3/4, dark yellowish brown; silt loam; weak, fine, crumb structure; loose dry consistency; friable moist consistency; slightly plastic; no cementation; diffuse smooth lower boundary
Ie	70-145	Fill; 10 R 3/6, dark red; silty clay loam; strong, fine, crumb structure; loose dry consistency; firm moist consistency; non-plastic; no cementation; Alluvial fill material deposited as grading material during development of area.
II	145-180	10 YR 3/3, dark brown; silt loam; moderate, fine, crumb structure; loose dry consistency; friable moist consistency; non-sticky wet consistency; non-plastic; no cementation; Possible natural sediment - contains charcoal, sm-med cobbles. Sediment sample collected at 154-166 cmbs

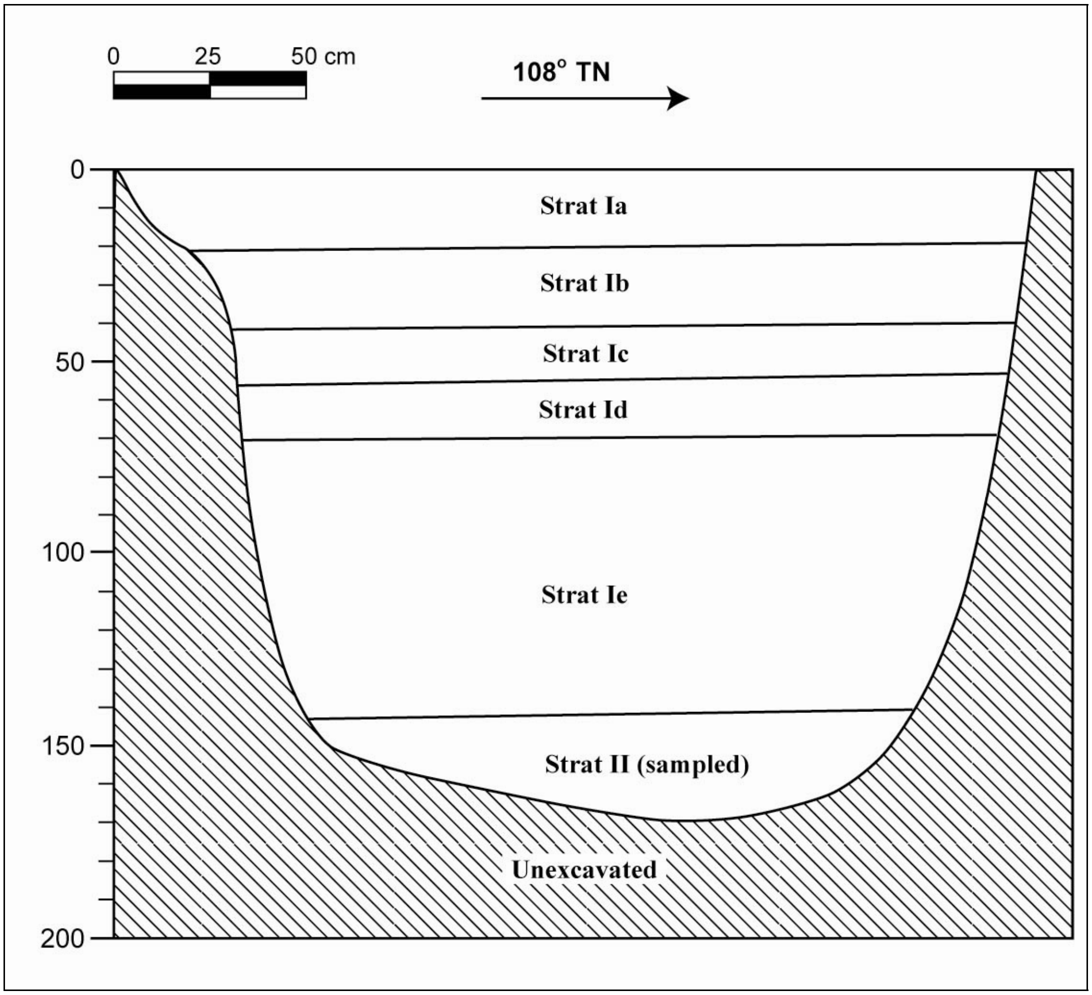

Figure 343. Profile of Column Test 30 (C-30)

Figure 344. Photograph of Column Test 30 (C-30), view to north

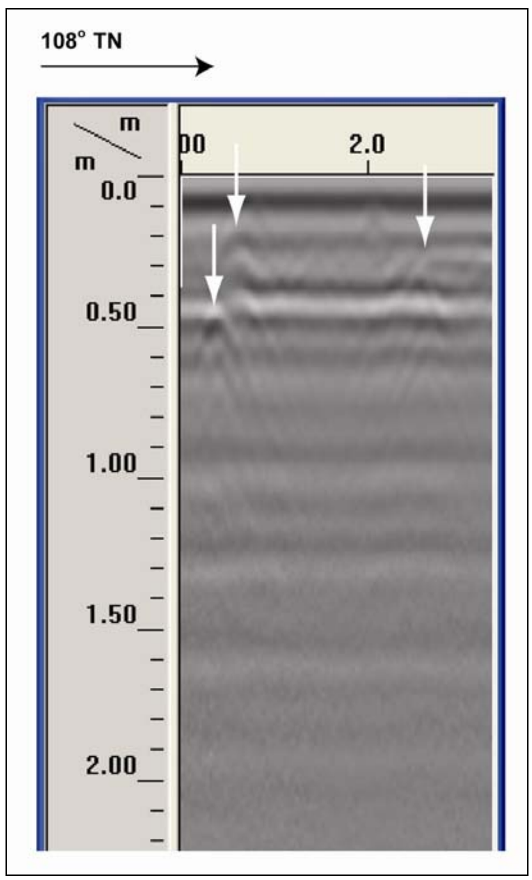

Figure 345. GPR profile of Column Test 30 (C-30)

Column Test 31 (C-31)

Orientation	110° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.75 m

Stratum	Depth (cmbs)	Description
Ia	0-20	Asphalt
Ib	20-40	Crushed coral fill
Ic	40-110	Fill; 5 YR 3/4, dark reddish brown; silty clay loam; moderate, fine, crumb structure; loose dry consistency; very firm moist consistency; slightly plastic; no cementation; clear wavy lower boundary; Grading material.
II	110-175	10 YR 3/3, dark brown; clay loam; strong, fine, crumb structure; very firm moist consistency; slightly plastic; no cementation; Compacted clay sediments, possibly natural layer, excavation stopped due to impenetrable layer.

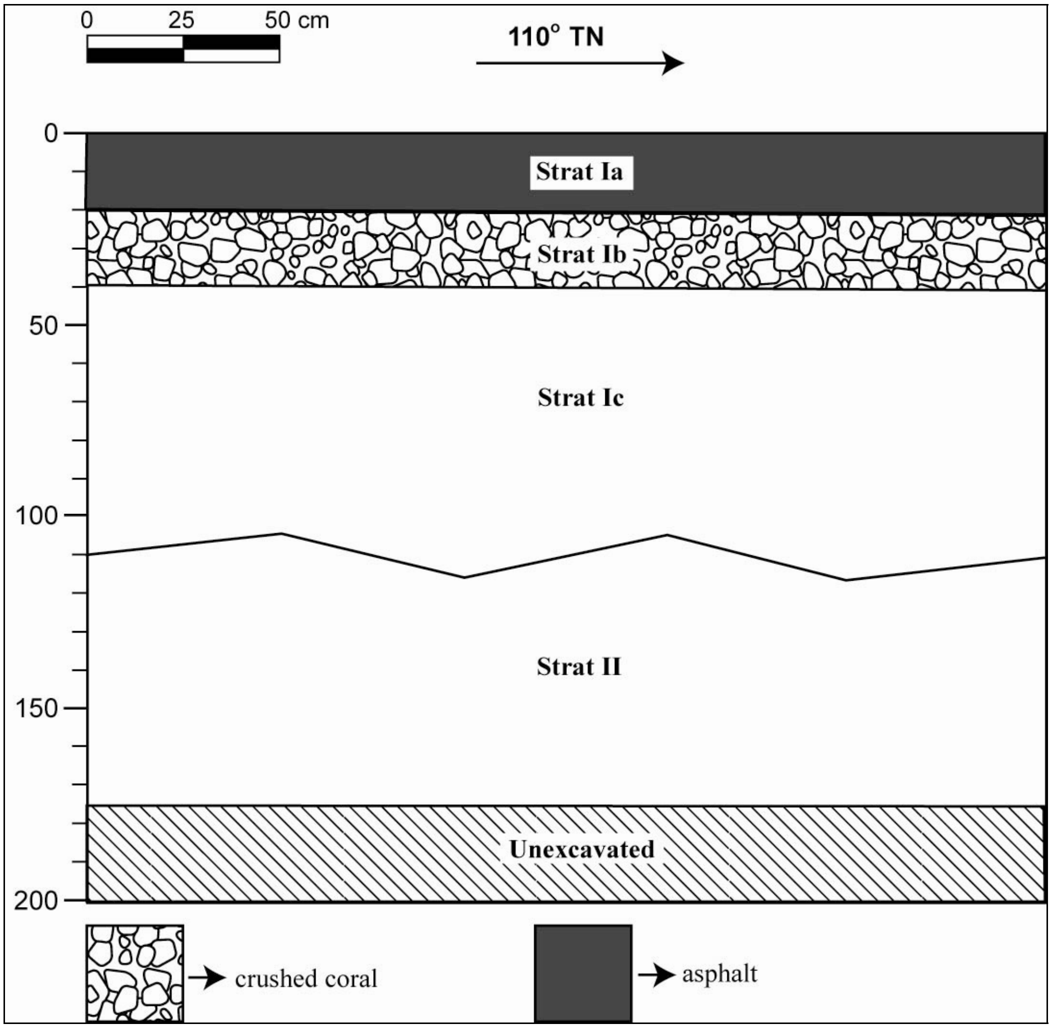

Figure 346. Profile of Column Test 31 (C-31)

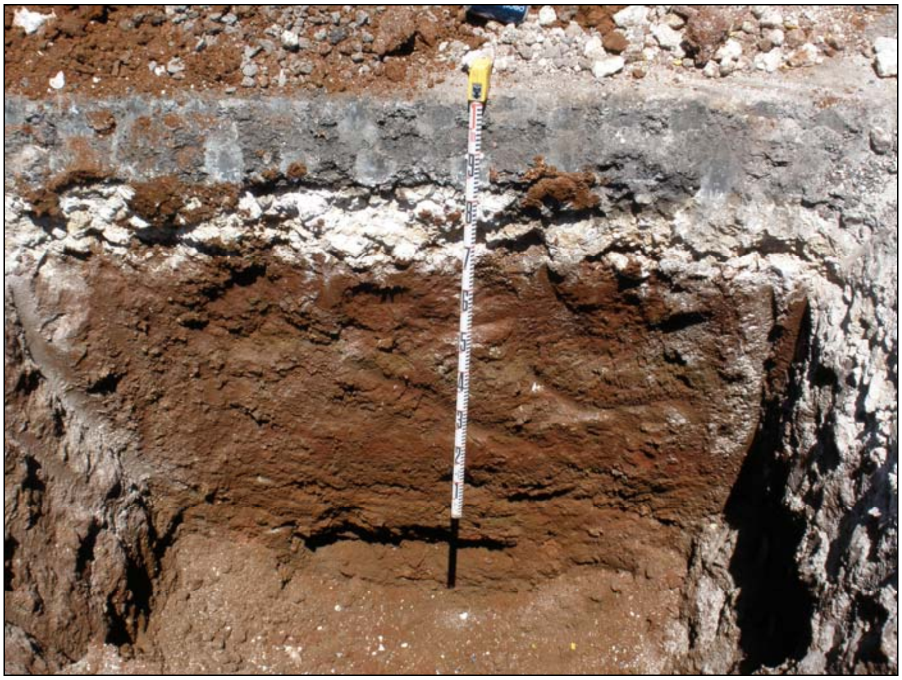

Figure 347. Photograph of Column Test 31 (C-31), view to north

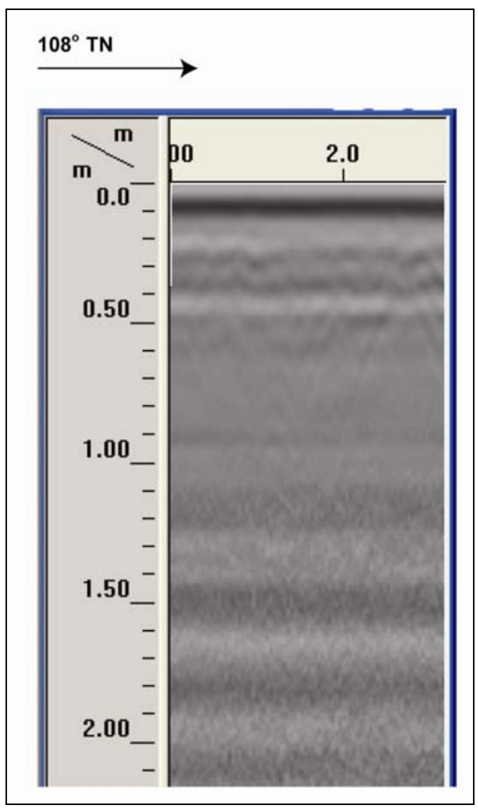

Figure 348. GPR profile of Column Test 31 (C-31)

4.16 Construction Sheet RW017

Construction Sheet RW017 includes a 300 ft (91 m) km segment of the proposed transit corridor (Figure 349). No test units were excavated within the area delineated by Construction Sheet RW017.

4.16.1 Pedestrian Inspection

The area along the transit route into the general Pearl City area becomes even more urbanized with existing buildings becoming more packed together and the existence of housing subdivisions just above the highway (Figure 350). As the route continues into Pearl City, towards Aiea and Pearl Harbor, there is a greater amount of development with housing, apartment buildings, condominium complexes, strip malls, and small businesses located closely together. As with much of the previous transit route, the development of the area has greatly impacted the Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

Figure 349. Construction Sheet RW017

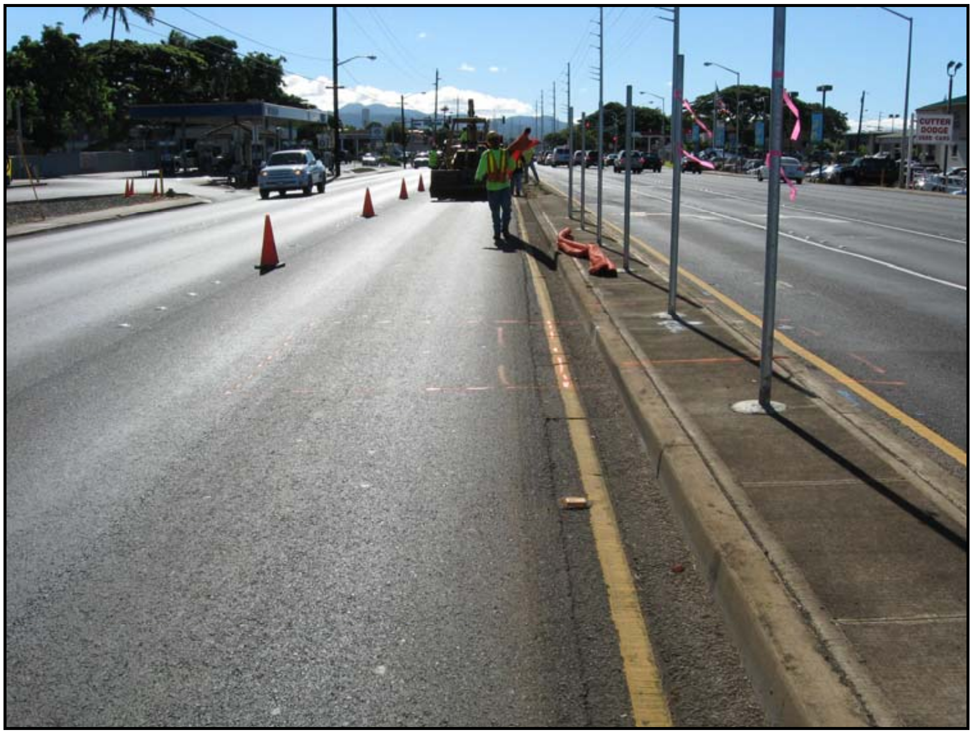

Figure 350. Photograph (view towards southeast) showing urbanized area of Pearl City along the route of Kamehameha Hwy and the transit

4.17 Cultural Resource Descriptions

4.17.1 State Inventory of Historic Properties (SIHP) # 50-80-9-7751

FORMAL TYPE:	Subsurface agricultural sediment (likely from cultivation of wetland *kalo* (taro)—buried lo*ʻi* (irrigated pond-field) deposit
FUNCTION:	Agriculture
# OF FEATURES:	NA
AGE:	Undetermined at this time, but likely pre-contact to post-contact
DIMENSIONS:	Observed over a 65 m E/W by 25 m N/S area, the overall extent of the subsurface layer is not known at this time
LOCATION:	*Makai* (southern) portion of the proposed Waipahu Transit Station UTM Coordinates*: 2364963N, 603290E
TAX MAP KEY:	[1] 9-4-019: 050, 061
LAND JURISDICTION:	Private

*UTM Datum = NAD 83, Zone 4N

SIHP # 50-80-9-7751 is located within the *makai* (southern) portion of the proposed Waipahu Transit Station, just south of Farrington Highway (Figure 351). The cultural resource was identified during the subsurface testing in the vicinity of the Waipahu Transit Center, the results of which are described above in Section 4.1.1--Construction Sheet RW011. The surrounding landscape in this portion of the survey area is fully developed with paved streets, paved parking lots, commercial buildings, and residential structures. There are no surface indications of archaeological cultural resources in the vicinity. Based on background research, however, it was understood that in the mid-1800s and likely much earlier into the pre-contact period, this was a well populated area that had abundant *loʻi* for cultivating taro. This information comes primarily from *Māhele* Land Commission Award (LCA) documentation, but also from other sources (e.g. Handy 1940; Cordy 1996 and 1997).

During the subsurface testing in this area, relatively thick fill layers were observed overlying the natural sediments. These fill layers are derived from both mass grading and in-filling associated with land reclamation, and more recent filling associated with roadway, landscaping, and parking lot installation. Beneath these relatively thick fill layers, marshy or wetland alluvial sediments were observed that indicated that former land surface in this area had been lower, closer to the water table, prior to the relatively massive fill episodes.

Within the footprint of the *makai* portion of the Waipahu Transit Station, just south of Farrington Highway, a distinct stratigraphic layer was observed, which, based on field observations and historical data, is likely the preserved remnant of a former *loʻi*. Described as Statum II in trenches 1-6 within the *makai* portion of the Waipahu Transit Center (refer to Section 4.1.1) this black (10 YR 2/1) clay contained noticeable, well-dispersed small flecks of

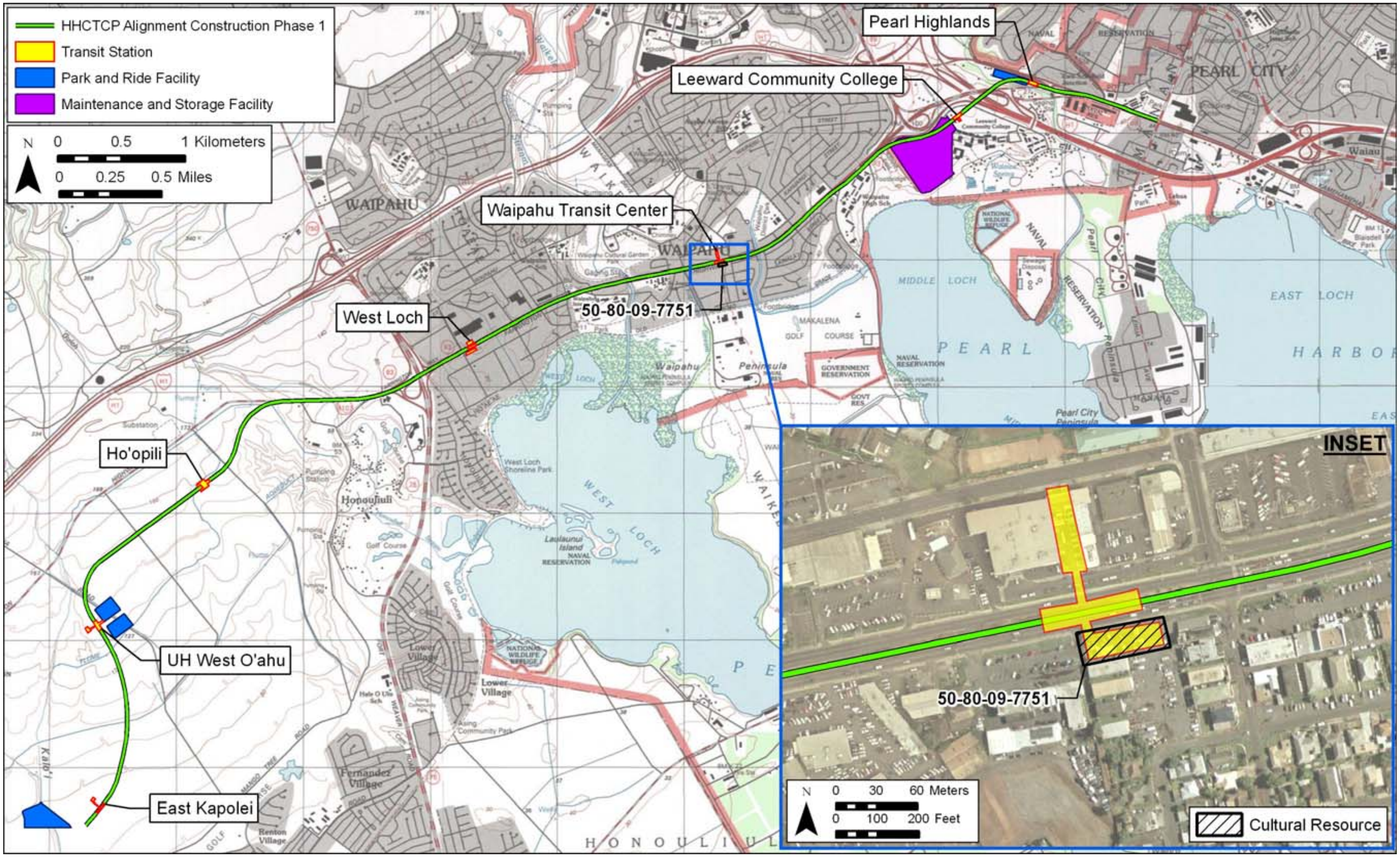

Figure 351. Location of SIHP #50-80-9-7751 within the project area

charcoal (generally less than 1-2 mm maximum dimensions) and many reddish-orange mottles (varying between 2.5 YR 5/8, 10 R 5/6, and 5 YR 6/8) (Figure 352 and Figure 353). Reddish orange mottling and dispersed charcoal are often associated with in-use and remnant (abandoned and buried) *loʻi* sediments.

A. Rose Schilt made the following observations while working with buried and abandoned *loʻi* sediments in Hanalei Valley, Kauai:

> Previous archaeological projects in Mākaha Valley, Oʻahu, and Hālawa Valley, Molokai have documented the appearance of pondfield soils in which irrigated taro has been cultivated (Morgenstein and Burnett 1972; Riley 1975). These soils are characterized by hydrated iron-oxide (limonite) tubes which appear as prominent reddish mottles. These ferrogenous tubes are known to develop around the roots of taro plants, although the mechanism of concentration is not well understood . . . These tubes or mottles were quite prominent in the soil core we took in a recently cultivated *loʻi* in Hanalei Valley. (Schilt 1980:29)

Regarding her extensive investigations of former *loʻi* in Luluku, Kāneohe, Oʻahu, Jane Allen made the following observations:

> In ponded soils, aeration along roots also oxidies small areas in the subsoil, resulting in bright mottling within a dark, glayed soil matrix; precipates of iron and manganese as limonite casts and manganese nodules, respectively, often occure . . . Charcoal in pondfields is typically churned and dispersed throughout the soil through subsequent cultivation and ponding activities. (Allen et al. 1987:36)

Morgenstein's work with abandoned and buried *loʻi* sediments in Kawainui Marsh, Kailua, Oʻahu documented abundant diffused charcoal particles and former root tubes stained red/oranged with "ferruginous oxyhydroxides," which were interpreted as directly related to the function of former pond fields (e.g. taro cultivation) (Morgenstein 1978:7-8). Based on Morgenstein's (1978) sediment profiles, the iron oxyhydroxide root tubes he observed in Kawainui Marsh were quite pronounced and very "tube-like." The stratum II observed at the *makai* portion of the Waipahu Transit Center (SIHP # 50-80-9-7751) clearly had diffuse charcoal particles and red-orange mottling, but the pronounced tube-like structures observed by Morgenstein (1978) where not visible during field observations.

It was only back in the laboratory, where sediment samples collected from SIHP # 50-80-9-7751 (refer to Figure 204 and Figure 219) were wet screen through 1/16-inch mesh, that the pronounced reddish-orange tubules and precipitate concretions were observed (Figure 354 and Figure 355). Five sediment samples, each approximately three liters in volume, from SIHP # 50-80-9-7751 were wet screened. The reddish-orange concretions were observed in all samples; the root tubules were observed in three of the five samples. The observed tubules are generally between 1 and 1.5 cm long and between 2 and 5 millimeters in diameter.

Figure 352 Close up photograph of a sediment sample from SIHP # 50-80-9-7751 (black and white scale in 1 cm units)

Figure 353 Close up photograph of a sediment sample from SIHP # 50-80-9-7751 (black and white scale in 1 cm units)

Figure 354 Close up photograph of iron oxyhydroxide root tubes (right) and and precipitate concretions (left) collected from sediment samples of SIHP # 50-80-9-7751

Figure 355 Close up photograph of iron oxyhydroxide root tubes collected from sediment samples of SIHP # 50-80-9-7751 (black and white scale in 1 cm units)

During the documentation of the six trenches within the *makai* portion of the Waipahu Transit Center, no berms, channels, or other potential field components or infrastructure were observed. The boundaries of this subsurface deposit are currently unknown, as the testing for the current investigation was limited to the project’s footprint. It is clear that this agricultural deposit was subsequently buried by modern fill events that brought the land surface to its current elevation. During these fill events, the deposit may well have been disturbed and cut away to varying degrees.

Land Court Application Map 1000 indicates numerous LCAs and ‘*auwai* (irrigation ditch, canal) in the vicinity of SIHP #50-80-9-7751 (Figure 356). Documentation from LCA 1712C and LCA 10512, both in the immediate vicinity of SIHP # 50-80-9-7751, indicate that wetland taro cultivation (*lo‘i*) was on-going in the area during the 1850s (see Appendix B for copies of this LCA testimony). The presence of ‘*auwai* and LCAs documenting wetland taro cultivation provide further evidence indicating that the clay deposit designated SIHP #50-80-9-7751, is likely a remnant of traditional Hawaiian agricultural activities.

Section 5.1, below, describes the results of radiocarbon dating at SIHP # 50-80-9-7751. These radiocarbon dating results are inconclusive because they are based on the analysis of bulk carbon from sediment samples as a whole rather than from charcoal from a specific event. These dating results indicate that the organic component of the sediments within SIHP #50-80-9-7751 was already formed approximately 1000 years ago. Further dating is required to determine the actual time frame for agricultural use of the pondfield sediments for irrigated agriculture. Based on contextual information, the deposit’s agricultural use likely began during the pre-contact period and continued post contact. Further investigation is required to substantiate this.

Admittedly, there is not a great deal of information available regarding SIHP # 50-80-9-7751, the remnant subsurface agricultural layer at the *makai* Waipahu Transit Center. Its boundaries are unknown and the radiocarbon dating results on sediment samples are problematic. Based on stratigraphic observations and historic data, however, there is little doubt that these deposits represent the buried remnants of former *lo‘i.* These deposits, on further investigation, can provide information on the age of the agricultural activity (best results are from radiocarbon dates from specific structural features, for example pond field berms). Sometimes information is available regarding periods of abandonment and reconstruction of the pond fields—allowing reconstructions of use over time. Through palynological analysis, these deposits can provide information on the surrounding environment (e.g. was the pollen rain in the surrounding watershed mostly indigenous species, Polynesian-introduced species, or Western-introduced species—and possibly how that pollen spectrum changed over time). Based on current evidence, these deposits contain sufficient archaeological information to be determined Hawaii and National Register eligible.

SIHP # 50-80-9-7751 has integrity of location and materials, but not integrity of design, setting, workmanship, feeling, or association. It is recommended National and Hawaii Register elibible under significance criterion D, for the archaeological information that it contains.

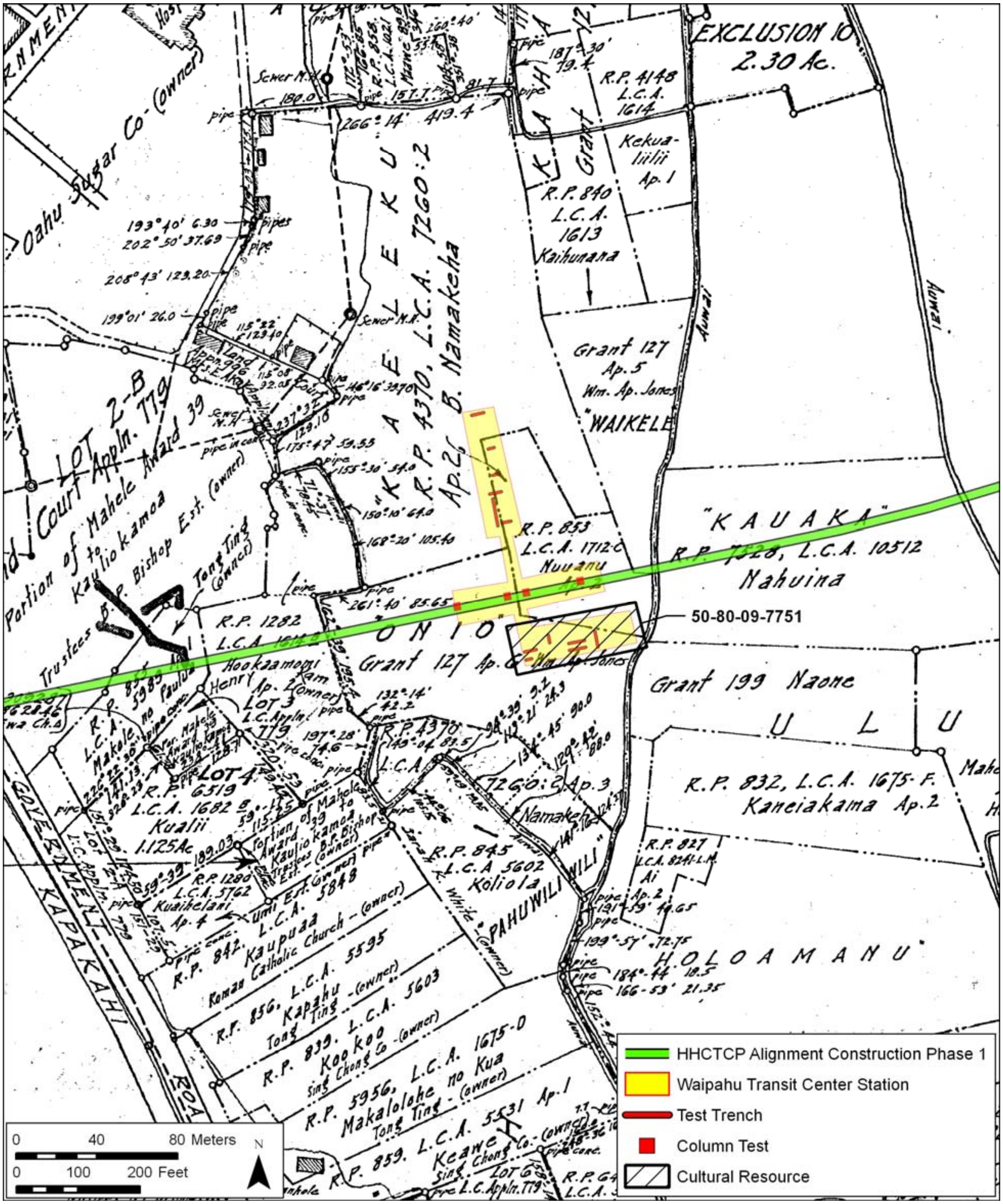

Figure 356. Land Court Application Map 1000 showing LCAs and *'auwai* in the vicinity of SIHP #50-80-9-7751